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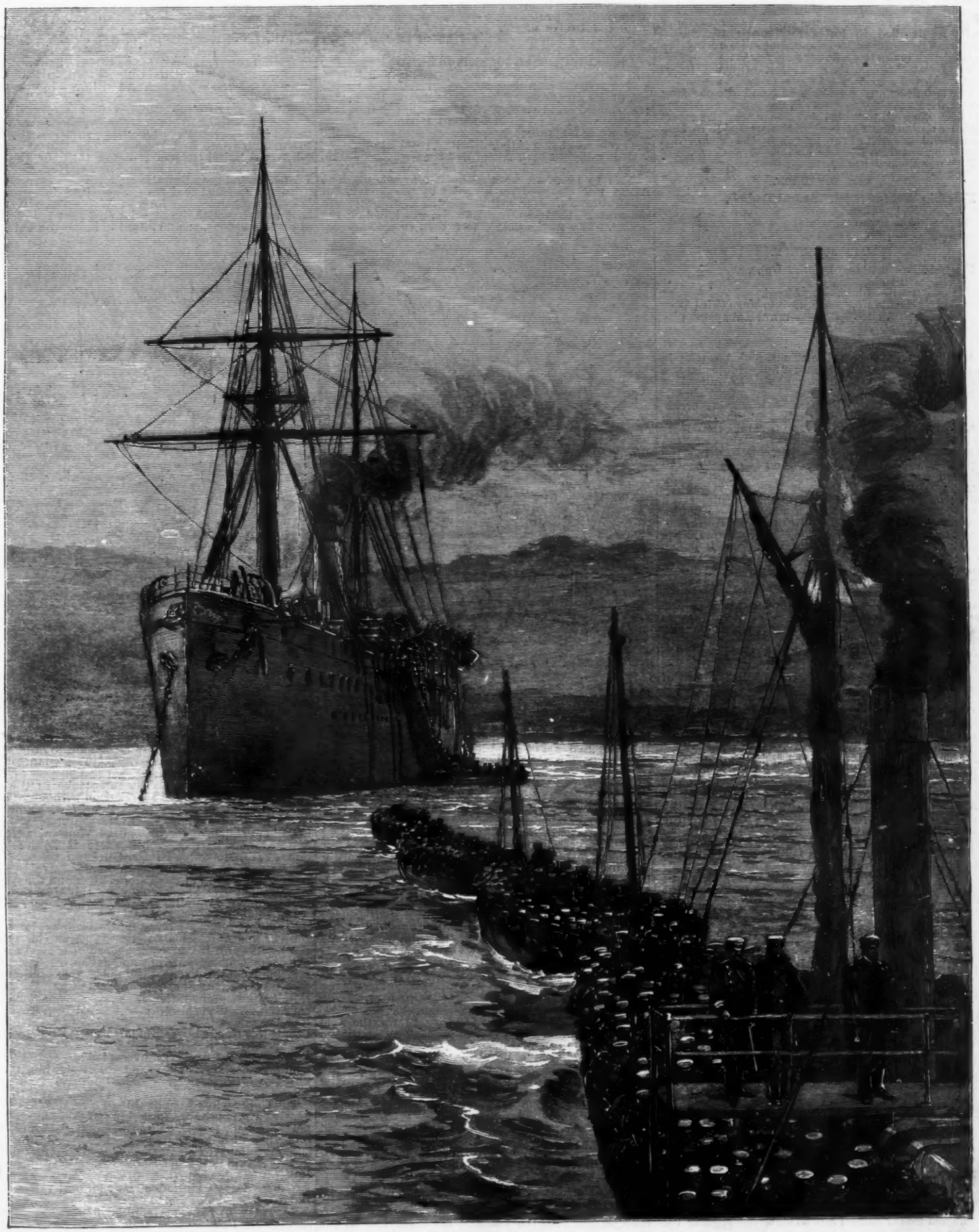


THE WAR IN THE EAST—THE LANDING OF JAPANESE TROOPS AT CHEMULPO.—From the London Graphic.

THE WAR BETWEEN CHINA AND JAPAN.

IN our last SUPPLEMENT we gave views and description of Port Arthur, the great naval stronghold of the Chinese, the capture of which by the Japanese has lately been announced. If this news proves to be correct, then a most serious if not irremediable blow has been inflicted upon the Chinese, which must have a powerful influence in bringing the Flowery Kingdom to terms. At the latest accounts the victorious Japanese army was advancing on Peking, and apparently it is hopeless for the disorderly armies of China to resist the splendidly drilled and resolute forces of Japan.

The Japanese have shown themselves to be soldiers in every sense of the word; but the wretched Chinese act like cowards, and seem to have little idea of the modern notions of fighting. They appear to have made little or no progress in military affairs during the last quarter of a century, but still hold to the idea of frightening away the enemy by means of noises and dragon-headed shields.

We give a sketch from the London Graphic of the mode of landing troops by the Japanese. Also a sketch map of the scene of hostilities. The New York World gives an account of the great naval battle of Yalu, as detailed to its correspondent Mr. James Creelman by Admiral Ito, the commander during the battle. We make the following abstracts:

The result of the battle is the loss of five Chinese men-of-war.

The two fleets met September 17, and the fighting lasted almost five hours. Early in the morning a Japanese fleet of eleven warships and the armed transport steamer Saikio Maru arrived on the west side of Haiyun Island, the first of the islands in the Yellow Sea stretching out from Port Arthur.

This was the order of the fleet:

VAN SQUADRON.

Flagship Yoshino (Rear Admiral Tsuboi),
Takachiho,
Akitsushima,
Naniwa.

MAIN SQUADRON.

Flagship Matsushima (Admiral Ito),
Chiyoda,
Itsukushima,
Hashidate,
Hiyei,
Fooso.
Akagi,
Saikio Maru (Vice Admiral Kabayama),

At about 11.30 o'clock the van signaled smoke in sight on the starboard bow, and a few minutes later a Chinese fleet of fourteen vessels was in full view, spread out in a single line of battle and sailing abreast on a northwest course. There was a good breeze blowing from the north, but the sea was not rough.

Admiral Ito signaled to the van to attack the enemy on the right, while he instructed the main squadron to attack the left. At the same time he ordered the Akagi and the Saikio Maru to get on the port side of the main squadron for safety. The presence of two large ironclads in the Chinese fleet convinced the admiral that he would have to maneuver under full steam and, by attacking the Chinese on their flanks, break their formation and throw them into confusion.

So the two Japanese squadrons swept on toward the enemy at full speed and the Chinese advanced slowly to meet them. When about three miles away the Chinese opened fire, and each of the Japanese squadrons changed its course, the van wheeling to the southeast and the main squadron turning south. The plan was to make two circles in opposite directions around the Chinese formation, and so prevent the big ironclads from getting any opportunity to close in and bring their heavy guns to bear.

As the Japanese were advancing on the flanks, it was impossible for the great line of ships to deliver effective volleys. All the shots fell short. The great speed of the Japanese made it impossible for the slower vessels of the enemy to change their line of battle in time. No reply was made to the Chinese fire until the attacking squadrons were within three thousand yards. Then Admiral Ito's squadron opened fire and the van squadron also joined the fight.

As the fleets drew closer together their guns roared from one end of the great battlefield to the other. The ocean shook with the tremendous shock, as the iron storm swept through whirling smoke and flame.

No men could be seen on the upper decks of the Chinese line. The crews were crowded below in true Mongol style. Nor was there any trace of boats in the davits of the Chinese ships. I have heard since that the fleet left all its small boats behind to prevent the men from deserting in the face of the enemy.

At first the Chinese gunnery was fairly accurate, but the wheeling movement of the Japanese on the right and left flanks, combined with the terrific effect of the rapid fire guns, seemed to throw the line into disorder and demoralize the gunners.

When the rear of the main Japanese squadron was turning the left of the Chinese, the Hiyei was so close to the enemy that to avoid receiving their fire broadside she left the main squadron and steamed straight at the Chinese line, passing between two large ironclads, the Tingyuen and Laiyuen, or the Kingyuen and Chingyuen. Right through the fiery gap she went, with Commander Sakurai on the bridge and all her guns at work, while her heroic crew cheered as two torpedoes, launched a hundred yards away, hissed through the waves and missed her. The enormous batteries of the two ironclads thundered away, and the Hiyei's decks were strewn with dead and dying men as she fled through the dense smoke between the floating iron forts.

She had passed half way through when a shell from one of the battle ships penetrated her side three feet above the water line, shattered the mizzenmast, killed the paymaster, two surgeons, all the medical attendants, spare helmsmen and machine gun ammunition carriers and destroyed the ward room. In a moment the Hiyei was on fire, and as the ship broke through the line and passed to the safety side of the Japanese main squadron her daring captain signaled that the flames would compel him to leave the regular formation.

Admiral Ito did not see the signal through the billows of cannon smoke rolling over the water and made no reply, so when the Hiyei had transferred her wounded to the transport ship she extinguished the fire and returned to her place in the squadron. She was almost a wreck, but managed to keep her guns going till the end of the battle.

The van squadron of the Japanese fleet, after attacking the right of the Chinese line, turned about and fought its way back toward the northwest, while the main squadron continued on in a circle, the Chinese formation being destroyed and the ships bunched together in confusion. The two ironclads stuck close together, fighting with great spirit.

Just as the flagship Matsushima, at the head of the main squadron, was abreast of the Chinese ironclads a shell from one of the big guns struck her main deck, dismounting her heaviest gun and damaging the whole port battery. The shell struck the ammunition massed on the deck and exploded it. A sheet of fire seemed to sweep up to the sky and the flagship rolled heavily as her riven sides yielded to the terrific shock and her plates were bent outward.

Dead men were blown into the sea, a part of the upper deck was blasted and the officers' quarters were destroyed. A lieutenant, a sub-lieutenant, a midshipman and twelve of the crew were instantly killed. Wounded men were scattered about in the bloody wreckage. The ship was on fire.

Admiral Ito kept his course until he found that the stiff wind on the port bow was spreading the flames, and to save the ship he turned about, followed by the rest of the squadron. From his place on the bridge the admiral could see that one of the Chinese ironclads was also on fire, and he decided to return to the attack, using his starboard battery while the fire on the port side was being extinguished.

Meanwhile the little Akagi and the transport Saikio Maru were separated from the main squadron, being unable to keep up with its swift movements. The Akagi was attacked on all sides by the enemy, but fought bravely. Her mainmast was shot away and her captain, Commander Sakamoto, was killed on the bridge. The navigating officer then took command, but a few moments later fell to the deck wounded in the face and arm. He was succeeded by the third lieutenant, who directed the fighting until the navigating officer's wounds were dressed and he returned to the bridge.

As the Akagi's mainmast crashed down over the side a lieutenant and gun crew in the fighting top were killed. The Chinese poured volley after volley into the battered ship, but the wounded lieutenant kept his place on the bridge and refused to surrender. After three hours of hard fighting he succeeded in withdrawing from the battlefield and getting under cover of the main squadron.

But the Saikio Maru! Hemmed in by the Chinese ships, the transport was a general target. Her upper works were riddled by the rapid-fire guns of the enemy, but she managed to escape the shots of the heavier batteries. By this time the Chinese fleet was disorganized and the gunnery was wild.

A torpedo was launched at the transport, but it exploded before reaching her. Another torpedo was sent from a ship not fifty yards away. A thrill of terror ran through the Saikio's crew as the huge projectile plunged into the sea, headed straight for the vessel. But the distance was not great enough for the style of attack and before the torpedo could rise to the surface it had passed under the Saikio's hull, and her astonished officers and men saw it come up on the other side and dart away toward the horizon.

A sudden burst of speed carried the transport to the shelter of the main squadron.

As the Chinese line was doubled up, the van squadron, under Rear Admiral Tsuboi, attacked the bewildered commanders, who seemed to have lost all thought of fleet formation, and were fighting at random. The main Chinese force had gradually drawn away from the protection of the ironclads, and each ship was acting on its own account.

At about 3.30 o'clock in the afternoon the Chihyuen began to sink, bow first. As she went down the Japanese guns pierced her again and again. Her crew jumped into the sea, and her stern rose in the air, the propeller wheel going at full speed.

For a few minutes she was completely hidden by clouds of smoke and steam. Just before she disappeared her propeller reached the water again, and she whirled around in the sea with mighty swirls, drowning men engulfed at every quivering sweep of the sinking ship. Then with a final shudder and lurch she plunged under the surface and was seen no more.

Two Chinese ships tried to withdraw from the action, but were pursued by the van squadron. The Laiyuen or the King Yuen suddenly keeled over on her port side and went down sideways. She was sunk by a stern shot, although it is almost certain that she was seriously injured before she attempted to break away.

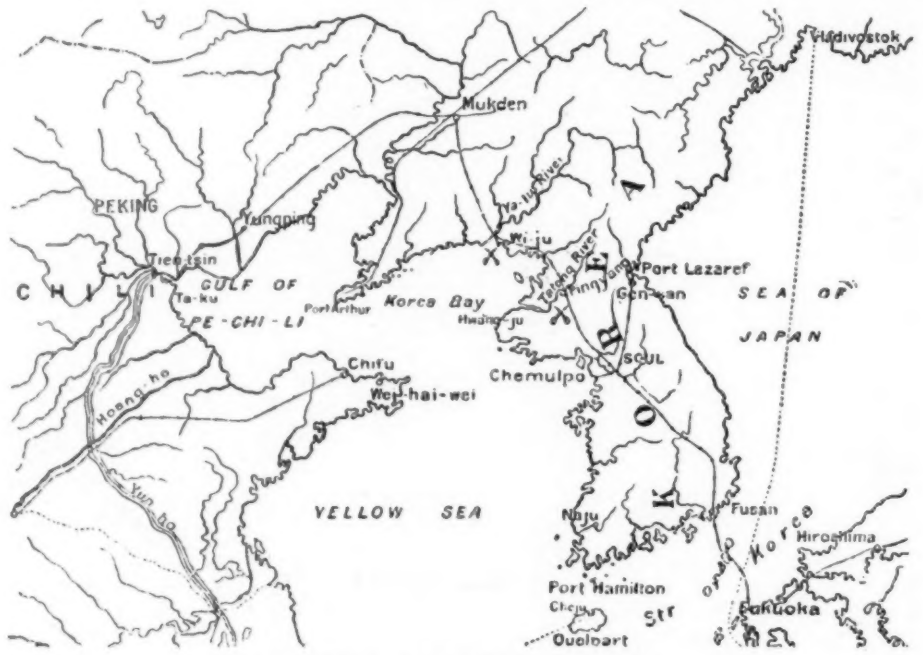
The wind lulled and the ocean was wrapped in smoke, through which shone the dull glare of a conflagration. The Tshaoyong was in flames, and the Japanese batteries were concentrating their fire upon her. Down went the cruiser with her shrieking crew, and a great cloud hid the spot where she disappeared in the distance, leaving a trail of dying men in the waves.

By this time the two Japanese squadrons were about five miles apart, with the Chinese main force between them. The squadrons were in perfect line, the main squadron advancing on the two ironclads, and the van squadron chasing two or three fugitives headed toward Port Arther.

It was now a few minutes past 5 o'clock. Admiral Ito feared that the two squadrons might be separated in the darkness, and, not daring to risk a fight at night with the ironclads and the Chinese torpedo boats, he signaled the van to join him and withdrew to westward of the Chinese.

At the same time the Chinese fleet reformed and shaped its course southeast. The Japanese squadrons took a parallel course, but kept at a sufficient distance to avoid an attack by torpedoes. The van squadron followed Admiral Ito and reported that the Chinese cruiser Yangwai was on fire and had started for Talu Island, probably to beach herself.

Ito was satisfied that the Chinese fleet intended to take refuge behind the forts of Weihaiwei. He felt confident that with the superior speed and discipline of his squadrons he could afford to renew the battle at daybreak, and he proceeded at full speed to the neighborhood of Weihaiwei. But in the morning there was no sign of the enemy to be seen. The Chinese had fled to Port Arthur. Ito steamed straightway to Talu Island. As he approached he saw smoke in the distance, but it vanished on the horizon without a trace of its origin being discovered. The Japanese believe that a fast torpedo boat was in the vicinity.



SKETCH MAP OF THE SEAT OF WAR.

"What do you chiefly attribute the success of the Japanese fleet?" I asked, as the admiral talked over the details of the battle.

"Largely to Providence," he answered. "The escape of the Saikio Maru from the torpedoes, for instance, was a miracle."

"Why did you not use torpedoes against the iron-

LIST OF LOCOMOTIVE ENGINES CONSTR CTED BY R. STEPHENSON & CO., NEWCASTLE-ON-TYNE, AND SENT TO AMERICAN RAILROADS. COMPILED FOR THE CHICAGO EXPOSITION, BY CLEMENT E. STRETTON, LEICKSTER, FROM THE OFFICIAL RECORDS WHICH EXIST IN ENGLAND AND AMERICA, 1893 AND 1894.

Date when Built.	Makers' No.	Name of Engine.	Name of Railroad.	No. of Wheels.	Class of Engine.	Notes and Remarks.
1828	12	America	Delaware and Hudson Canal Co	4	Cylinders outside	Built to the order or Horatio Allen.
1831	17	Whistler	Boston and Providence	4		Built to the order of Captain Whistler.
1831	23	Delaware	Newcastle and Frenchtown	4	Cylinders inside	
1831	24 (?)	John Bull	Mohawk and Hudson	4	Cylinders inside	
1831	25 (?)	Stevens—John Bull	Camden and Amboy	4	Cylinders inside	Name changed from Stevens to John Bull, on arrival in America, 1831 (at Chicago Exibition, 1893).
1832	27	Boston	Boston and Worcester	4	Cylinders inside	Built to the order of Mr. Jackson.
1832	28	Phœnix—Maryland	Newcastle and Frenchtown	4	Cylinders inside	Name changed from Phœnix to Maryland, 1832.
1832	5	Pennsylvania	Newcastle and Frenchtown	4	Cylinders inside	Maker's No. appears out of order.
1832	7 (?)	Herald	Baltimore and Susquehanna	4	Cylinders inside	A leading bogie placed under this engine on its arrival in America, 1832.
1832	8 (?)	Stephenson	Boston and Lowell	4	Cylinders inside	
1833	42	Davy Crockett	Saratoga and Schenectady	6	4-wheeled bogie and 1 pair of drivers	A second pair of drivers added 1835–1836.
1833	52	Virginia	Newcastle and Frenchtown	4	Cylinders inside	
1833	54	Edgefield	South Carolina	4	Cylinders inside	A 4-wheeled bogie added in America, 1834.
1833	60	Brother Jonathan	Mohawk and Hudson	4	Cylinders inside	
1833	61	Robert Fulton	Mohawk and Hudson	4	Cylinders inside	
1833	75	Fire Fly	Saratoga and Schenectady	6	4-wheeled bogie and 1 pair of drivers	
1834	87	William Aiken	Charlestown and Columbia	4	Cylinders inside	A 2-wheeled truck added in America, 1835.
1834	99	Elias Houz	Charlestown and Columbia	4	Cylinders inside	
1834	103	Richmond	Richmond, Fredericksburg & Potomac	4	Cylinders inside	
1834	104	Pennsylvania	Pennsylvania Railroad, P.R.R. Portage	6	4-wheeled bogie and 1 pair of drivers	A second pair of drivers added, 1836.
1834	105	Philadelphia	Pennsylvania Railroad, P.R.R. Portage	6	4-wheeled bogie and 1 pair of drivers	
1834	106	H. Schultz	Charlestown and Columbia	6	4-wheeled bogie and 1 pair of drivers	
1834	107 (?)	Meteor	Boston and Worcester	4	Cylinders inside	
1835	110	Kentucky	Philadelphia and Columbia, P.R.R.	4	Cylinders inside	
1835	112	John Bull	Philadelphia and Columbia, P.R.R.	4	Cylinders inside	A 4-wheeled bogie added 1837.
1835	113	Atlantic	Philadelphia and Columbia, P.R.R.	4	Cylinders inside	
1835	114	Sumter	South Carolina	6	4-wheeled bogie and 1 pair of drivers	A second pair of drivers added 1837–8.
1835	115	Marion	South Carolina	6	4-wheeled bogie and 1 pair of drivers	
1835	116	Ohio	South Carolina	6	4-wheeled bogie and 1 pair of drivers	
1835	117	Comet	Boston and Worcester	4	Cylinders inside	A 4-wheeled bogie added in America, 1835.
1835	119	Rocket	Boston and Worcester	4	Cylinders inside	A 2-wheeled truck added in America, 1836.
1835	120	Mercury	Boston and Worcester	4	Cylinders inside	
1836	121	Jupiter	Boston and Worcester	4	Cylinders inside	
1836	125	Wayne	Wilmington and Raleigh	4	Cylinders inside	Another pair of drivers added in America.
1836	126	Nash	Wilmington and Raleigh	4	Cylinders inside	
1836	129	Nottoway	Lexington and Ohio	4	Cylinders inside	
1836	139	Elkhorn	Lexington and Ohio	4	Cylinders inside	
1837	151	Baltimore	Baltimore and Susquehanna	6	1 pair small and 4 coupled drivers	On arrival in America the front small wheels were taken out and a 4-wheeled bogie put in. They then had 8 wheels.
1837	152	Susquehanna	Baltimore and Susquehanna	6	1 pair small and 4 coupled drivers	

clads? I thought that was the fundamental principle of an attack on armored battleships by weaker vessels."

The admiral winced and hesitated. I had hit him in a tender spot.

"The distance was too great," he said.

Notwithstanding this statement of Admiral Ito, I have already learned on unimpeachable authority that there was not a torpedo in the Japanese fleet. I cannot say who was responsible for this grave omission. It is the one serious blunder made by the Japanese since the beginning of the war. Had the fleet been provided with torpedoes, it is reasonably certain that one or both of the Chinese ironclads would have been destroyed. The absence of torpedoes is all the more surprising considering the magnificent equipment of the two squadrons in other respects and the admirable way in which they were handled.

The only new idea in modern naval warfare which was thoroughly tested in this engagement was the rapid-fire gun. Admiral Ito said that it played a most important part in the battle.

"Our fleet carried forty-six twelve centimeter rapid-fire guns and four fifteen centimeter rapid-fire guns," he said. "Each gun fired about forty shots during the fight, which makes 2,000 shots for the combined batteries, not counting the other guns. The rapid-fire cannon is a splendid weapon, and we were able to embarrass the enemy's gunners. When I learn something of the Chinese killed and wounded, I will compare the figures with the number of shots we fired. The result ought to be very interesting."

"Of course you know how deeply Americans are interested in the question of speed and its relation to the fighting efficiency of the navy," I suggested. "You have had a good chance to test your fast ships in action, and your opinion ought to be worth something now."

"Nothing but our speed enabled us to keep our formation," the admiral replied. "The Chinese were slow, and we kept our squadrons moving so swiftly on the right and left of their line, that they could keep no order of battle. I am convinced that speed is the first thing to be looked for in a warship. I thought so before this battle, and I am now more thoroughly convinced. For squadron fighting ironclads are vital. The part played by the two Chinese battleships saved a great part of the enemy's fleet."

"You must have been glad when darkness came on, admiral. Providence and darkness were on the side of Japan."

"No, no!" said the admiral, shaking his fine head. "I was anxious to continue the fight, but I would not chance a struggle in the dark with ironclads and torpedo boats. With our fast ships we were able to keep our formation and attack or retire at will. The Chinese had to fight on our terms, not on their own. I am ready to fight the Chinese fleet to-morrow, ironclads and all, if it will only come out where I can meet it."

The admiral laughed when I asked him what he thought of the Chinese as sea fighters.

"They are very brave men," he said. "Not a ship hoisted the white flag, and their gunners kept at work all the time, although their aim was not very good toward the end. Yes; the Chinese fought courageously. No man can deny it. While they preserved their fleet formation they showed wisdom in their fighting, but after we broke up the lines each captain seemed to be acting independently. But the two ironclads were well handled. I must say that."

And so ends the first real trial of strength on the sea between the forces of civilization and barbarism in Asia.

THE EXTERNAL COLOR DECORATION OF BUILDINGS.*

By T. G. CESARE FORMILLI.

AMONG the many considerations suggested by the works of the old masters in art, there is one concerning the external decoration of houses which leads to the inquiries: Why is it that to-day, when the words "old masters" are on the lips of all, when we consult and study them, that we do not take examples from the various methods that they had of externally decorating their edifices with such beautiful effect? and why do not we also unite coloring with architecture? Color does not disturb form in any way; in fact, when color is well conceived, it greatly helps to bring out the full beauty of form. The Assyrian art, the Egyptian, Greek, Roman, Arabian, Gothic, and, finally, the art of the fifteenth century, entered into the decoration of innumerable edifices of great importance, some with monochrome colors and some in polychrome; while we, with few exceptions, when we want to do something above the ordinary level, generally resort simply to the usual terra cotta or stone of uniform color and to very little else.

We must, however, here note that, in spite of the general similarity of the external decorations of the present age, we see in them from time to time a tendency to more closely study the old masters, and we notice a certain revival of old ideas of great artistic value relating to external decorations in color.

There is much that could be said about the art of uniting color with architecture in the Greek and Roman periods, but the time is too limited on this occasion to attempt to cover so extensive a field. I will, therefore, limit myself to a few remarks about the methods adopted by the fifteenth century artists for adding beauty and variety to their edifices. I ought also to say that among the many and varied styles of external decoration of the different artistic periods in different countries, that used by the fifteenth century masters, which lends itself so particularly to our requirements, greatly surpassed every other style of decoration which had, up to that period, been used. What have we, it may be asked, more beautiful in external decoration than the immortal majolica of the Della Robbia, and the graffitos, chiaroscuros and frescoes of Polidoro da Caravaggio, Pellegrino da Bologna, Maturino Fiorentino, Guilio Romano and Raffaelle? These artists, who possessed such refined taste, covered many and many external walls of houses and palaces, which, for the proportions of the windows, the elegance of the columns and that of the cornices have excited immense admiration, and yet those beautiful and various decorations, framed, as it may be said, by the surrounding elements of architecture, have hardly been considered worthy of study, except in very rare cases.

Rome, Florence, Venice and many other principal and secondary cities of Italy can give innumerable examples of the beautiful art of external decoration, which, in virtue of the material used and the mode in which the work was done, have endured through many centuries, as well as the architectural stone work which incloses them.

However, we must note that in those golden times the term "decorator" conveyed something more elevated and noble than it is frequently understood to mean to-day. In fact, in the past, a Michael Angelo, a Raffaelle, a Cellini, were embraced in the title of decorator. Whereas in these days it is rarely that we see a work of industrial art executed by an artist of high reputation; there seems to be a prejudice against such work. Why, then, do we not entirely abolish this prejudice? Why do not artists who have great names, and those who have not, return to those good and wise traditions of the old times? What variety, what elegance of effect might be added to the many houses that are now being constructed with so much good architectural taste if there were introduced in some or all of the blank spaces decorations of majolica, graffito, chiaroscuro or fresco as in the fifteenth century.

Let us, however, now pass on to the principal methods of external decoration most used in that period, beginning with that of majolica.

Besides being extremely beautiful, the majolica decoration has the advantage of preserving the walls by preventing the penetration of moisture into the interior, and thereby protecting in the same way both the owner's property and the occupier's health. As is generally known, external decoration in majolica is often seen in the southern climates, whereas, in England, if used at all, it is chiefly for interiors. If we ought to believe in the old Latin saying, utile dulce, majolica would hardly be selected for the internal decoration of dwelling houses in cold climates, for, although in a certain sense it must be considered useful, it certainly would tend to discomfort indoors under ordinary circumstances during cold weather.

Externally, however, as already said, it protects the walls from rain, fog and from dirt, presenting at the same time to the eye a magnificent and varied effect. We may imagine the effect of the front of a house well designed by the architect for the application of majolica, having beautiful freizes, medallions, panels, etc., in this material, and of truly artistic creation in the sober sense in which the old masters intended. A large frieze, as made by Luca, Giovanni or Andrea Della Robbia, with spaces between the windows, fitted with beautiful symbolical figures representing, for example, scenes from family life, or fitted with scenes of child life, as Andrea fitted the famous medallions which decorate the space above the arches of the Hospital of the Innocents, in Florence.

What beautiful and sublime external decoration is made by the five figures of Giovanni Della Robbia, in Pistoia, namely: Faith, Hope, Charity, Prudence and Justice; also by the immortal frieze called "The Seven Works of Mercy," of which beautiful copies can be seen at South Kensington Museum, and which are good in any case as an inspiration in that class of external decoration. Not less important or beautiful are the medallions of the arms of the King of Anjou, and the months of the year, both by Luca, and also found among the many treasures of the same museum.

It would be too long to enumerate the many examples of decoration in majolica by the Della Robbia family, who began with Michael, born about 1320, followed by Luca about 1399, by Andrea in 1435, and by Girolamo in 1488. Afterward one branch of this family became almost French, and finished with Guido Della Robbia, who did not reach the age of touching the clay, but died in 1625, at the age of only five years.

GRAFFITO.

Another system of external decoration not less beautiful, and well adapted to resist atmospheric changes, is, without doubt, that of graffito, which was adopted with immense technical and artistic knowledge in the renaissance of Italian art.

Such decoration, whether it be for its weathering powers in severe climates or for the magnificent artistic and, at the same time, subdued effect which it produces to the eye, certainly merits being considered as beautiful as decoration in majolica.

On the Continent, and especially in Germany and Italy, the art of graffito is extensively used, but here in England many must regret that graffito decoration has been almost entirely neglected. It is difficult to account for this, unless it is due to erroneous impressions that the English climate would injuriously affect the work, or that it may be too expensive for general application.

Regarding the cost, I need only say that it would compare favorably with any decoration, even if it were of the simplest description, in stone or terra cotta.

As to the durability of graffito, it is, if properly executed, quite capable of resisting heat, frost and rain, because it presents a very hard surface, and is much less porous than ordinary stones or bricks, while it lends itself to being easily washed, which is an advantage in foggy and smoky atmospheres. Of the very few examples of graffito existing in London, that which is at South Kensington, although not executed according to the method of real graffito, affords, nevertheless, good evidence that decorations of this character do not suffer materially from long exposure to atmospheric changes. If they are a little darker in tone than when they were executed, they still are perfectly distinct and, without doubt, of a finer tone and more harmonious than when done by the artist. Here I ought to add that the work just mentioned is cut much deeper than graffito as intended by the old masters in this art—masters to whom we ought to feel deeply grateful for having added this treasure to their already invaluable bequests.

Vasari wrote of the graffito of his day, and gave considerable information about it. He referred to it in words which may be translated as follows: "Artists have another sort of art, which is called graffito, and serves for ornamenting the fronts of houses and palaces, which may be quickly decorated by such a system, and more surely resists the rain. Its durability is entirely due to the etching on the wall instead of being simply drawn in chiaroscuro or in colors." He then describes the process of preparing and tinting the cement or plaster which is to be laid on the part of

* A paper read at a meeting of the "Art Workers' Guild," London, on October 5.—The Builder.

the building to be decorated, and which forms the background of the work, and explains how this is afterward covered with a wash of lime of travertino, through which the lines are etched with an iron point. He further describes how backgrounds are obtained by the entire removal of the surface wash, and shows how strong projecting shadows for grotesque figures or designs of foliage may be produced by adding stronger shades of the same color to the background.

Referring again to the graffitos at South Kensington, they may be described as low relief in graffito rather than graffito proper, because the cut into the plaster or cement bed is excessively deep. The depth of the cut made with the iron or steel point by the artist in that particular work is a disadvantage, necessitated by plastering on the final coat instead of merely washing it on. So deep a cut gives a hard appearance to the design, and impedes the water from running off the walls, while tending to accumulate dirt. The true Italian graffito is without this inconvenient feature, because the depth of the cut is scarcely perceptible. The cut or score made by the instrument does not generally exceed the thickness of a sheet of drawing paper, or, in other words, very little more than the thickness of the surface layer with which the bed work is covered. Extremely beautiful effects can be produced under these conditions, perhaps more beautiful than can be obtained with a soft pencil on a rough paper. The weight of the leaning point of iron is itself sufficient to remove the light surface and to make the dark background appear without fatigue to the hand.

In some backgrounds colors in monochrome are sometimes added, and these are treated just as you treat fresco, which is very easy after experience has taught the difference between the tint in its wet and dry state. Some of the finest and richest effects are reached by the addition of gilding to some part of the graffito, as ribbons, fruits, arms, etc. The gold, however, must be added when the graffito is perfectly dry.

Naturally there is much in graffito decoration that experience teaches, but it is not very difficult to execute, and it seems to be deserving of more attention in these days of progress, in virtue of its durability as well as of the excellent effects it lends itself to producing. There seems to be a good field open for teaching graffito decoration in the art schools which have been so largely established in this country.

There are still other modes of decorating the exterior of edifices which were adopted by the fifteenth century artist, namely: That of chiaroscuro in fresco, and of fresco in colors. The first has, at a distance, all the appearance of graffito, and, although the design is not cut, it has similar color and effect.

Much was done in this style by Maturino Fiorentino and Polidoro da Caravaggio, both of whom arrived to the highest point in this art of decoration with their immortal work of chiaroscuro in fresco in Via della Maschera d'Oro in Rome. Many other examples could also be mentioned, but as this work is the most important among the others, it will suffice as an illustration of this beautiful art. The frieze representing historical scenes is the most important decoration, and in a certain sense it recalls to mind the sequence of pictures which compose the triumph of Cesare, by Mantegna, at Hampton Court.

Speaking of fresco, what is meant is the real Italian fresco, and not tempera or incausto, which is occasionally confused with it. As an external decoration, it may be considered to be truly ideal, and it is to be regretted that in England it appears to be absolutely out of fashion.

Outside fresco, when it is done with good and pure earth colors, upon suitable lime mixed with much sand and puzzolana of that sort which the Romans used on the Colosseum, becomes very solid, hard, lasting and washable, just like compact and durable stone.

It is really to be regretted that to-day the exterior of buildings is so much limited in the matter of decoration to frames, columns, or, in a few words, to architectural mouldings, whereas the old masters of nearly all ages introduced into their edifices all that contributed beauty. Why, it may be asked, render so poor the mother of all arts—the one which more directly speaks to our souls, which is so impressive, which cheers and covers us?

ARTIGUE'S VELVET CARBON PHOTOGRAPHIC PAPER.

THE processes employed in the printing of photographic negatives do not all present a sufficient guarantee of preservation. Every one has remarked that many of the old prints upon silver salt paper in his possession have a tendency to alter, and that some even disappear at the end of a relatively short time. This is often due to the little care with which the washing and fixing have been done. Still, it would be impossible to absolutely guarantee the complete inalterability of a proof printed upon paper sensitized with silver and fixed with hyposulphite of soda, whatever be the care used in the different manipulations required.

One of the most interesting questions for the future of photography is being studied more closely and closely every day, and the special journals are filled with interesting articles upon the subject; but the general conclusion is that, although with care it is possible to guarantee a long life to a print, one cannot be sure that it can be preserved indefinitely, and this has an interest from the view point of the documentary photographs that we leave to future ages.

Happily we can have recourse to other and surer processes, such as printing with fatty inks, which is rather reserved for the industries, and carbon printing, which is more within the reach of amateurs. Here an inert powder is used for the production of the image, and chemical reactions do not intervene for the fixing of the image. This process, however, is not as widely employed among amateurs as it ought to be, because it requires operations that are somewhat delicate, and success is not always obtained. We know, in fact, that it is based upon the property possessed by bichromated gelatine of assuming a degree of insolubility proportional to the intensity of the light received. The inert and impalpable colored powder selected is so mixed with the gelatine as to form an emulsion, which is spread upon the paper. In this state its preservation is indefinite. At the moment of using it the paper is sensitized by immersing it in a 5 per cent. solution of bichromate of potash, and, as soon as it is dry, the printing is effected in a frame by putting a negative in contact with the sensitized coating. But no apparent modification is produced. It is necessary to estimate the time of exposure by comparison with another kind of printing or by means of a photometer. This may be done quite easily.

In order to develop the image, it is necessary to immerse the paper in tepid water, when all the non-insolated parts will dissolve and the others remain. But the insolation having been gradually effected by penetration through the stratum of gelatine, the surface in direct contact with the negative will have become entirely insoluble, except in the blacks, and the half tones will, therefore, show themselves upon development on the other side of the film formed by the emulsion, that is to say, on the side that is in contact with the paper that serves it as a support. Hence the necessity of detaching this film in order to place it under another support before proceeding to the development; hence the inconvenience, too, of having, in consequence of this operation, a reversed proof in which the right becomes left, and the necessity, after development, of making a second transfer to the definite support in order to put things in their proper place.

We have desired to recall the principle of the carbon process very briefly in this place, in order to point out what in our opinion is the cause of the want of success among amateurs; but we hasten to say that some of them are employing it with success, and that those professionals who have made a specialty of this kind of work are succeeding in obtaining some wonderful results, and, to mention but a single example of these, the Braun establishment, of Paris, has acquired a universal reputation for its reproductions of paintings and engravings obtained thereby.

Mr. V. Artigue, of Bordeaux, has thought that if it were possible to simplify the method by suppressing the transfers, and to obtain a positive directly with silver salted paper, a great progress would be accomplished. Continuing the experiments made in this direction by his father a dozen years ago, he has succeeded in manufacturing, under the name of "velvet carbon," a paper that gives excellent results.

The principle is the same as that of which we have above spoken. The colored powder is incorporated with a colloid substance which, like gelatine, possesses the property of becoming insoluble proportionally to the insolation that it has received. We do not know what the substance is that is employed (gum or albumen—perhaps both); that is the inventor's secret.

However this may be, the results are very fine, and the method of using necessitates no transfer. Moreover, it is quite original, since the developing is done by means of sawdust.

The paper is furnished either in rolls or sheets, but not sensitized. When it is desired to use it, it is impregnated with a 5 per cent. solution of bichromate, either by immersing it wholly in a tray or by painting the opposite side with the emulsion by means of a brush or a tampon. The inventor thinks that this means is much preferable, because of the beauty of the final result. We have tried both, and do not find any great difference. Whatever be the method of sensitizing employed, the drying is done in darkness and the printing is afterward effected in a frame. The image is not seen to appear any more than it does in the carbon process. Mr. Artigue recommends the use, as a photometer, of a strip of strongish white paper that has been sensitized in the bichromate bath and dried at the same time as the rest. This strip, of a bright yellow color, is placed between two pieces of cardboard, and about a quarter of an inch of the end of it being drawn out and exposed to the light at the same time that the negative is, assumes a darker and darker color up to a maximum that no longer varies. At this moment, a little more of the paper is drawn out, and, having been exposed to the light, soon assumes the tint of the first, and so on, each of these sections representing one degree of the photometer. Upon a preliminary experiment, the printing of the negative is arrested at the end of two or three degrees, and upon development it will be seen whether the exposure has been too long or too short. The subsequent printing will consequently be modified, and upon the type negative will be noted the number of degrees necessary to obtain a good result. Such an experiment having once been made, certain data will have been obtained for the future.

The development is proceeded with as soon as the paper is taken from the frame, or a few hours afterward if it is preferred; but one should not wait for several days, since the paper will not keep after it has been sensitized. We now prepare in an earthen pan a mixture formed of three quarts of sawdust and the same of tepid water. This is stirred with a thermometer, and, by means of boiling water, the mixture is raised to temperature of 27° C. exactly. The mixture is quite sufficient in quantity to preserve this temperature for a long time. This being ready, the positive is plunged into cold water in order to soften it, and is then fixed by clips upon a sheet of glass resting upon the frame that supports the sawdust mixture. It is possible, if one desires it, to fix the print simply to a strip of wood held in the hand. Then the mixture is put into a coffee pot having a wide nozzle, and is poured therefrom over the upper part of the positive from one to the other, so that it shall spread everywhere and fall back into the pan. After continuing thus, the image will be seen gradually to appear. If there has been an over-exposure and it comes too quickly, we use a colder mixture (at about 20°), which has been prepared in advance in another pan. If, on the contrary, there has been an under-exposure, the temperature is raised to 29°. It will be seen that the process of development leaves a certain latitude in the estimate of the time of exposure.

It will be understood that in this operation no chemical operation intervenes; there is merely a slow and uniform mechanical action which gradually, and proportionally to the insolation, disengages the coloring matter imprisoned in the colloid substance. The inventor has endeavored to effect this work in different ways—with a brush, a pencil, sand, etc., but, during the ten years that he has labored upon the question, no process has succeeded better in his hands than the one that we have just indicated.

The proof having once been developed, is simply washed in cold water in order to remove every trace of the bichromate, and is then ready to be mounted upon cardboard.

It will be seen that transfers are completely suppressed, and two chances of failure are thus avoided. The results are certainly at least as fine as those given by the ordinary carbon process, and we strongly recommend amateurs to try this kind of printing, which will give them inalterable and artistic proofs.—G. Mareschal, in La Nature.

DEVELOPMENT OF A PHOTOGRAPH BY MEANS OF SAWDUST

THE SCIENTIFIC APPLICATIONS OF PHOTOGRAPHY.*

IT is not so very long since photography occupied a very subordinate position in the world alike of science and of art. Scientific men looked on photography as a mere art, artists regarded it as a mere science. About twenty years ago, when I suggested that some improvement in a photographic process—I forget now which—ought to be brought before the Physical Section of the British Association, I was told that there was nothing scientific about photography, that it was a mere empirical pursuit, unworthy the attention of serious students of science.

And to a large extent the reproach was well deserved. Though the list of the earliest workers in photography contains many illustrious names, yet it is true that a large proportion of the most important contributions to photographic knowledge were not made by scientific workers, or by men who worked in scientific methods. They were obtained by practical men, seeking for results, often indeed seeking for them successfuly by methods which could not have commended themselves to men better equipped with scientific knowledge. Of course this was the consequence of the fact that photographic science was early associated with photographic practice, and the same remark holds good of other sciences—electricity, for instance—in which theory and application to practical use advance with equal steps; but I think it applies more to photography than to any other.

At the present time we have indeed reached a very different condition of things. All the most striking of the recent advances in the science are the result of elaborate scientific research. The most recent im-

* Extracted from the address of the president, Sir Henry Trueman Wood, to the Royal Photographic Society, 9th October, 1894.

provements in lenses were the fruit of long and laborious investigation into the optical properties and the chemical nature of certain sorts of glass. The increased speed of modern plates, and their improved power of rendering color values more truly, have only been obtained by minute knowledge of the condition of the problem to be solved, and by careful application of the most recent results of chemical and physical research. If the old photographic crux—the reproduction of color—has been solved, or, at all events, if a possible method has been indicated for its solution, it was not by haphazard experiment, but by careful adjustment of means to secure an anticipated result. Nowadays we can only hope for improvement by utilizing the advance of scientific knowledge.

But if the present position of photography is due to progress in the kindred sciences, how amply has she repaid the debt. There is not a single branch of science in which photography is not largely used. There are many whose progress is now absolutely dependent on the power of the camera to observe more accurately, more independently, more minutely, more rapidly, more permanently than the human eye. If, as appears to be the case, we have reached the limits of human vision, aided by the most delicate instruments that can be constructed, it is difficult to imagine what limits need be set to photographic vision, can we but construct instruments of accuracy sufficient to allow its full powers to be utilized.

The advantages of the "retina which never forgets," and, it might be added, which never tires, which accumulates weak impressions and stores them up till they become one strong one, were long since recognized by De la Rue, and I suppose it will not be very long before, for astronomical purposes, eye observations are entirely superseded by photographic. The photographic camera is now an indispensable adjunct to every large telescope, if indeed it would not be equally correct to say that the telescope is an adjunct to the camera, since the astronomical telescope tends more and more to assimilate to the form adopted long since by Mr. Rutherfurd, in which the visual rays are of but slight importance, and the chief attention is given to the accurate utilization of the more chemically active rays at the violet end of the spectrum.

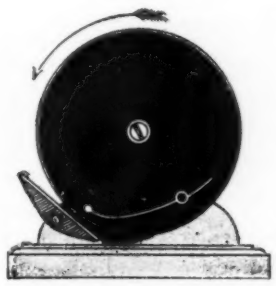


Fig. 1.

Fig. 2.

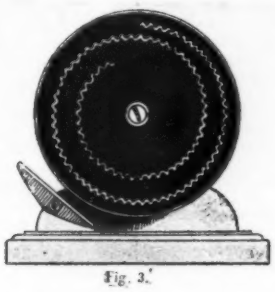


Fig. 3.

When we are told that a photographic plate has recorded 10,000 stars in an area not containing a single visible star, one may be excused an expression of wonder as to how the human mind is ever to grapple with problems of such infinite complexity, to turn to useful account observations dealing with such enormous multitudes.

As an automatic recorder of scientific observation, photography seems to have been utilized in the Royal Observatory about 1847, under the superintendence of the venerable ex-president of the society, Mr. Glaisher, who has been kind enough to furnish me with particulars of the methods originally devised by Mr. Charles Brooke, and successfully worked for many years by Mr. Glaisher and his staff.

The method was first applied to record magnetic variations and the movements of the barometer and thermometer. In the case of the former, a ray of light reflected from a mirror carried by the magnet was focused on the surface of a cylinder covered with sensitized paper. The cylinder was rotated by clockwork, the result being, of course—in the way now commonly employed for such automatic records—to give, when the image was developed, a record of the movements of the magnet. A base line was given by an invariable spot of light, and by intermissions of this light a time record was provided. Similar results were obtained in the case of the barometer, by using a float with a small perforation through which the light passed, and with the thermometer by simply allowing the mercury itself to screen the light from the sensitive surface.

Later on, in 1865, similar means were used by Mr. Glaisher for the automatic record of earth currents, and they have, consequently, been continuously observed since that date at Greenwich.

To the best of my knowledge, but little alteration has been made in the original system, the only improvement being in the sensitive surface employed. When gelatino-bromide paper was introduced, it was tried and adopted at Greenwich, and by its means superior results were obtained.

Numerous instances will occur to many of you in which photography has been or might be applied. I will only refer to one, because it appears to me so excellent an instance of the delicacy of the method. At the last, the Oxford, meeting of the British Association, Mr. Burch showed to the newly-formed Physiological Section photographic records taken with the aid of the capillary electrometer of electric currents produced by speaking into the telephone. The letter z produced a complicated curve in which oscillations of current lasting only $\frac{1}{350}$ second were visible with a lens.

The meteorologist has been enabled by its aid to study the form and nature of clouds, the shape and character of the lightning flash. The zoologist has been taught much about animal motion. The microscopist has long learned to rely on the camera as the only accurate means of reproducing the objects of his studies. The physicist has by photographic methods investigated many phenomena in which the changes are too rapid for the human eye to follow them. By such means Lord Rayleigh and Prof. Boys have obtained long series of pictures of occurrences which all took place within a fraction of a second, thus almost analyzing time as the chemist analyzes matter.

The uses of photography, in ethnology, geology, geography, natural history, archæology, are too obvious to need mention. They and many other applications may be summed up in the remark, that whenever the observer of natural phenomena requires to make an accurate record of his observations, photography supplies the means.

THE PHOTO-CHRONOGRAPH.

ONE of the greatest triumphs of modern science is the precise measurement of periods of time almost infinitesimal. We can determine the millionth of a second by means which we possess. The most potent of these powers which we have at our disposal is, without doubt, the revolving mirror, or what is still better (because it substitutes photography for the human vision), a rotating sensitive plate, or a combination of the mirror and plate. It is by this method that Wheatstone measured the velocity of electricity and Foucault the velocity of light, and by which Fedderson measured the discharge of a Leyden jar. These measurements require complicated arrangements and some subsequent calculations. When we wish to measure thousandths of a second, we generally have recourse to clock-work set in motion by electricity and indicating the time on large dials, or to tuning forks giving a fixed number of vibrations per second, which are registered on a moving cylinder. The latter method is adapted in the photo-chronograph of M. D. Tissandier, which will prove useful in determining the length of photographic exposures. The photo-chronograph consists of a rotating disk, having its face smoked or otherwise darkened, and a spring attached to the disk, the end of which is whitened. This spring is put in motion by the lever shown at the bottom of the engravings. The photo-chronograph is intended to be used principally to measure the speed of photographic shutters. To measure a shutter the instrument is set up, facing the camera in a strong light—sunlight, if possible; the lever is worked and the spring begins to vibrate, the disk is then set in motion and the result of a short exposure is shown in Fig. 2, the white tip of the spring making the curves as shown. Knowing the speed of vibration of the spring and the rotation of the disk, it is very easy to calculate the speed of the shutter from the length of the sinuous lines which were photographed on the plate. If the duration of the exposure is greater than the time consumed for the disk to make one revolution, the instrument can be easily modified to record the exposure in the form of a spiral. For our engravings and the foregoing particulars we are indebted to Le Monde Illustré.

TEXTILE SOAPS.*

IN the manufacture of textile fabrics of all kinds soap is largely used for various purposes. The woolen manufacturer uses it to free his raw wool and his cloth from the grease which it naturally contains or which is imparted to it during the process of manufacture; he also employs it as an aid in the milling of his goods. The silk manufacturer employs it to free his silk from the gum and dirt it naturally possesses. The dyer uses it in certain branches of his art. The calico printer employs it for clearing his cloths of the starch and gum he uses in his colors and to brighten the tints he has produced. The bleacher employs it in the scouring of the yarns or cloths he has to deal with. It will thus be seen that soap is of no small moment to the textile manufacturer.

It must however be obvious that owing to the diversity of uses to which the soap is put in the various branches of this industry that it may, in fact it does, happen that a soap which would suit very well for one particular purpose will not do for another. The woolen manufacturer may use a soap which would spoil the colors of the calico printer, while the silk manufacturer likes to have as good a soap as he can get.

It is not the present intention of the writer to enter into a detailed theoretical dissertation on the properties of the soaps which may be employed in the various branches of the textile industry, although a little will be said on this point, but rather to describe the kinds of soap employed and tell the soap maker how to produce them. It will perhaps be convenient to consider them from the point of view of the particular industry.

Silk Soaps.—Soap is employed in the treatment of silk in two ways, first for the purpose of boiling off the silk, that is to separate the silk glue or sericin with any dirt it may be contaminated with from the true silk fiber or fiberin. To effect this without leading to any deterioration of the silk fiber as regards strength and luster it is necessary to employ a pure neutral soap and one which shall be freely soluble in water. On this account it is desirable to employ an oil soap, and the best oils to make it from are olive oil, palm oil, cocoanut oil or ground nut oil. Tallow soap is not soluble enough for this purpose and cotton oil soap is not satisfactory and can scarcely be made sufficiently neutral. The soaps used in the silk trade are well prepared curd soaps. A very good formula is 5 cwt. olive oil, 1 cwt. palm oil and 1 cwt. ground nut oil. The oil should be well boiled until there is no appearance of fat, while but a slight excess of alkali is perceptible to the taste. Then the soap can be salted out and finished in the usual way. A soap made in this way will be found to give very good results in boiling off soap.

Soap is also employed in the dyeing of silk. No special kind is needed. The one just described will be found a good one.

Wool Soaps.—It is in the woolen industry that soap is most largely used. In this trade it is employed in at least three stages of the manufacture of the raw wool into the woolen cloth.

First it is employed in the cleansing or scouring of the raw wool to free it from the grease and dirt it naturally contains, second it is employed to free the wool from the oil which is put in the wool to enable it to spin and weave easily, and thirdly in the process of milling or fulling, to facilitate the felting of the wool fibers together. It must be obvious that a soap which will give good results in the first of these treatments may not, in fact will not, give good results in the second. Yet it is no uncommon thing to find a woolen manufacturer only using one kind of soap for all.

A word or two may be said as to the best kind of soap to employ. Undoubtedly this is a potash soap. Potash is, so to speak, the natural alkali of the wool fiber. We find that it naturally contains potash salts and potash soaps. A potash soap leaves the wool fiber distinctly softer and more lustrous than does a soda soap, while being much more soluble in water, a stronger liquor can be made. Yet few woolen manufacturers use a potash soap. The extra cost deters them, and so they employ a soda soap. On the other hand, it may be stated that for milling the wool a potash soap sufficiently neutral has not yet been made, and so the fuller or miller of woolen cloths has perforce to fall back on a soda soap.

The soap commonly used in the cleansing or scouring of wool to free it from the natural grease and dirt or from any acquired oil it may contain is a curd soap made from bone fat or some other moderately cheap grease or soap fat. It is not necessary that it should be free from free alkali; in fact, a slightly alkaline soap is, if anything, preferable in the writer's view, as that alkali serves to act upon and bring about a more perfect emulsification of the wool oil and grease and so enable it to be more completely extracted from the wool. The soap should however be pure, that is free from any filling of any kind, as such would undoubtedly have a detrimental effect on the wool, besides causing the scouring baths to become too highly charged with material and so reducing their solvent powers for the grease, etc., of the wool.

Olive oil or ground nut oil would make a better soap for the wool than bone fat or tallow, as the soap made from them is more soluble in water. The expense of such oils and the keen competition in these days prevent them from being used. Cotton seed oil may however be used with good results.

The soap which is used in the milling or fulling of the woolen goods must however be neutral in its properties, for it has to come in contact with colored goods and it must have no effect, whatever, except possibly that of raising or brightening the colors, on the color of the goods. A neutral soap has no such effect, a soap which has alkaline properties may have; for of course its action will depend upon the character of the dyestuffs used in dyeing of the goods, and this possibility must be avoided, and so a neutral soap should be used. The soap too must be pure, for any filling that may be put in might add to the alkalinity of the color or detract from the milling properties of the soap. The soap too should be as soluble as possible in water and an olive oil or ground nut oil soap will answer very well. A palm oil soap is a good one to use. A cotton oil soap does not work well, seeming to part with its alkali too freely. The soap should be as free as possible from color, so that it will not sadden any colors with which it may come in contact. A practical soap maker will have no difficulty in producing such a soap.

Soaps for Cotton Goods.—Soap is used for a variety of purposes in connection with the treatment of cotton goods, not only on account of its cleansing properties but for other properties it possesses.

Cop Soap.—A soft soap has been found to be very good to apply to the bottoms of cops during the process of manufacture. It enables the threads at the bottom of the cop to hold together more firmly. For this purpose the soap must be soft and also be free from color. The latter condition can only be attained by using a white fat-like tallow, cocoanut oil or bleached palm oil, and if soda be used for making the soap by

* From the American Soap Journal.

leaving plenty of water in. A common cop soap is made from 1 cwt. tallow, 20 lb. bleached palm oil and 20 lb. castor oil, saponifying with a solution of 21¼ lb. 77 per cent. caustic soda in 20 to 25 gallons of water. When thoroughly saponified the soap is ready for use, it not being necessary to salt out. One objection to a soda cop soap is that they contain an excessive quantity of water and have a tendency to dry up, when they become useless for the purpose in question. A potash cop soap is therefore the best, and such a soap can be made from 1 cwt. of tallow, 28 lb. cocoanut oil, 20 lb. castor oil and 28 lb. bleached palm oil saponified by boiling with 39 to 40 lb. caustic potash dissolved in 7 to 8 gallons of water. The question of alkalinity in a cop soap is a matter of no importance.

Calico Printers' Soap.—The calico printer employs soap for the purpose of clearing away all traces of the thickening which he has to add to the colors which he uses for the purpose of printing with them. He also employs the soap for the purpose of brightening the colors.

A soap for this purpose must be quite free from free alkali, or otherwise there would be a tendency to affect many of the tints, alizarine reds would be turned crimson, some colors would bleed. Another sine qua non is that the soap must not leave any rancid smell in the cloth, nor must it impart any color. Experience has shown that the best soaps for this purpose are pure soaps made from olive oil or bleached palm oil, well saponified and cleansed from excess of alkali. Such soaps are fairly soluble in water, which is also an important point, leave little odor behind them, and what little this is is pleasant rather than otherwise. A soap with a good deal of filling, no matter what that might be, is of no use to the calico printer.

The cotton finisher makes use very largely of soap and what he calls soap softening. These are nothing but highly watered soaps. The soap is used for the purpose of imparting a soft, full feel to the cloth. It must be free from color; hence it must be made from good tallow, cocoanut oil, olive oil, ground nut oil or bleached palm oil. If the soap is going to be used with white goods, a little free alkali in it does not matter, but if it is going to be employed in the finishing of dyed or printed cotton cloths, then it does matter, because it may have an action on the shades of the dyed goods, and this must be avoided.

Soap softenings contain anything from 50 to 80 per cent. of water. There is no trouble in making them. All that is necessary is to boil up some hard soap with the required amount of water. A good many are made by the cold process, especially those made from cocoanut oil, and many of the best are made in this way. It is much easier than to make a hard soap by the ordinary plan than to boil up with water. Some makers prepare special softenings, to which they add a little borax.

FUSION AND VOLATILIZATION PRODUCED BY MEANS OF THE HEAT OF THE ELECTRIC ARC.*

By HENRI MOISSAN.

IN a series of memoirs inserted in the Bulletin de la Soc. Chim., we have shown that by a sufficient elevation of temperature, obtained by means of the electric furnace, it is possible to effect in a few moments the crystallization of metallic oxides, the reduction of certain oxides, the fusion of refractory metals, and the distillation of silica and zirconia.

In the present paper we insist especially on the volatilization of the metals and the metallic oxides.

When it is required to condense the vapors of substances not easily volatilized at high temperatures, we use a metallic tube cooled internally by a current of water. It is known that H. Sainte-Claire Deville, in his researches on crystallization, obtained interesting results by this method.

In these experiments we made use of a copper U-tube, of 15 millimeters in diameter, traversed by a current of water at a pressure of about ten atmospheres. The curved part of the tube was introduced into the furnace at 2 centimeters from the arc, above the crucible containing the substance to be volatilized. A sheet of asbestos pasteboard placed on the aperture which admits the cold tube allowed of the condensation of the metallic vapors issuing from the furnace.

As an instance of the use of the cold tube, we mention the action of heat on the two stable mineral compounds, magnesium pyrophosphate and silicate.

The pyrophosphate was submitted for five minutes to the action of an arc of 300 amperes and 65 volts in the electric furnace. After a few moments, abundant vapors were evolved. The cold tube placed in the apparatus was traversed before the experiment by a current of water at the temperature of 15·4°. At the end of the experiment, when the furnace was still in full action, the temperature of the water was only 17·5°. Under these conditions, the vapors produced in the furnace condensed with the greatest readiness on the cold tube. When it was withdrawn from the furnace we found that it was in great part covered with ordinary phosphorus, which took fire on friction or became slowly oxidized in the air, yielding a sirupy coating, which reduced silver nitrate abundantly. Besides this phosphorus, we were able to detect on the tube the presence of magnesia.

In another experiment we heated asbestos (magnesium silicate containing a little iron) for six minutes in a coke crucible. The current measured 300 amperes and 75 volts. After the experiment there remained in the crucible merely a very small quantity of melted silicate and a ferruginous globule with a brilliant fracture and containing 1·6 magnesium and 7 silicon.

The cold tube was covered with a gray powder containing a large excess of silica, of magnesia, and very small quantities of carbon and silicon. We found spheres of transparent silica, scratching glass and giving distinctly the reaction of silica with a bead of phosphorus salt.

These two preliminary experiments, which we select among many others, prove that the most stable salts are dissociated at the temperature of the arc, and that it is possible to collect the products of their decomposition and to study them with ease.

VOLATILIZATION OF METALS.

Copper.—A fragment of copper of 103 grammes is placed in the coke crucible of the electric furnace. It is heated for five minutes with a current of 350 amperes and 70 volts. After a minute or two, flames of 0·04 to 0·05 meter in length issue forcibly at the apertures which give passage to the electrodes on each side of the furnace. These flames are surmounted by torrents of yellow smoke produced by the formation of copper oxide from the combustion of the metallic vapor. After five minutes the current is stopped, when the ingot remaining in the crucible weighs only 77 grammes; 26 grammes have thus been volatilized. All round the crucible, in the horizontal part between the cover and the furnace, we find a broad halo of globules of melted copper, derived from the distillation of the metal. The yellow vapor collected gives up copper oxide to cold dilute hydrochloric acid, and leaves as a residue small spheres of metallic copper, black on the surface, and soluble in nitric acid. On the cold tube we find abundance of metallic copper.

Silver.—It has long been known that silver is volatile at a high temperature. In the electric furnace it may be brought to full ebullition. It then distills more readily than silica or zirconia. We collect abundance of melted globules, an amorphous gray dust, and absorbent fragments.

Platinum.—When heated in the electric furnace platinum melts in a few moments and is quickly volatilized. We collect metallic platinum in small brilliant globules, and in dust on the cooler parts of the electrodes or under the lower brick at a few centimeters from the crucible.

Aluminum.—Heated for six minutes; current of 250 amperes and 70 volts. We obtain on the cold tube a gray powder, slightly agglomerated, which, on agitation with water, lets subside to the bottom of the vessel minute globules of aluminum. These spheres have a metallic aspect; they are attacked by hydrochloric or by sulphuric acid, with escape of hydrogen. In the vapors escaping from the furnaces we may also collect on the asbestos pasteboard small metallic spheres covered with alumina.

Tin.—Duration of the experiment, eight minutes. Intensity of the current, 380 amperes and 80 volts. When the furnace is in full action, abundant white fumes escape near the electrodes. We find on the tube a small quantity of tin oxide, soluble in dilute hydrochloric acid, small brilliant globules, and a gray fibrous substance forming a felt. This fibrous portion and the metallic spheres consist of metallic tin, and they give off hydrogen on treatment with hydrochloric acid. It is easy to condense on the exterior part of the furnace small globules of metallic tin mixed with oxide.

Gold.—Duration of the experiment, 6 minutes. Intensity of current, 360 amperes and 70 volts. We put 100 grammes gold into the crucible; after the experiment there remained only 95. During the experiment abundant fumes were evolved of a greenish yellow color. The cold tube was covered with a powder of a dark color having purple reflections. Under the microscope with a low magnifying power we distinguish clearly small regular globules of melted gold of a fine yellow color. These globules dissolve readily in aqua regia and give all the indications of salts of gold.

On the asbestos pasteboard where the vapors of the furnace are condensed we found at the hottest point numerous very small globules of metallic gold. Around this part, which had a very distinct yellow color, was found a red halo, and beyond that a fine deep purple tint.

Manganese.—This metal, to the volatilization of which M. Jordan has recently called attention, has yielded very interesting results. We describe here only a single experiment, which seemed to us quite characteristic. Duration, 10 minutes; intensity of current, 380 amperes and 80 volts. In the crucible there were placed 400 grammes of manganese. Very plentiful fumes were given off during the experiment, and at the end there remained merely a regulus of metallic carbide weighing only a few grammes.

Whenever in the preparation of manganese in the electric furnace we heated too long there was no metal found in the crucible.

Iron.—Duration of the experiment, 7 minutes. Intensity of the current, 350 amperes and 70 volts. We collected on the cold tube a gray powder presenting some brilliant surfaces, very slender and warty, malleable enough to bend under the blade of a knife, mixed with a gray powder having the color of iron reduced by hydrogen. This powder became brilliant under the burnisher, and the entire specimen dissolved in dilute hydrochloric acid, with a discharge of hydrogen.

On the asbestos pasteboard on which the metallic fumes were condensed we collected small globules of magnetic oxide and spheres of the same compound of a black color and a wrinkled surface.

Uranium.—Duration of the experiment, 9 minutes. Intensity of the current, 350 amperes and 70 volts. We collect upon the cold tube small metallic globules, full and abundant, mixed with a deposit of gray powder easily soluble in acids, with an escape of hydrogen. The solution presents all the characters of uranium salts. On the asbestos pasteboard we find numerous yellow globes, which, if crushed in an agate mortar, lose a crust of oxide, become gray, and take a metallic aspect. These globules of distilled uranium do not contain carbon and are not attracted by the magnet.

NON-METALS.

Silicon.—With a current of 380 amperes and 70 volts we can effect the volatilization of silicon. We find upon the cold tube small globules of melted silicon, soluble in the mixture of nitric and hydrofluoric acids. These globules are mixed with a gray dust and a small quantity of silica. If we collect the vapor upon asbestos pasteboard, we see that the chief part of the silicon has been converted into silica.

Carbon.—Duration of experiment, 12 minutes. Intensity of current, 370 amperes and 80 volts. On heating a crucible filled with coarse fragments of charcoal all the mass of carbon is quickly converted into graphite. After the experiment we find upon the cold tube slender plates, very light, translucid, and presenting a maroon color by transmitted light. M. Berthelot, in his numerous experiments on the progressive condensation of carbon, has already indicated the existence of a light carbon of a maroon color. This substance is separated by dilute hydrochloric acid from the lime which is volatilized at the same time. The residue thus obtained, the study of which we are pursuing, burns readily in oxygen, producing carbonic acid.

OXIDES.

The researches above indicated on the crystallization of oxides abundantly demonstrate the volatility of these oxides. We will put it in evidence for the oxides previously regarded as infusible, lime and magnesia.

Lime.—With a current of 350 amperes and 70 volts we obtain the volatilization of lime in from 8 to 10 minutes. Under these conditions we collect lime on the cold tube in the form of an amorphous dust, presenting no globules. Vapors of calcium oxide escape from the furnace in plenty. With a current of 400 amperes and 80 volts the experiment is effected in 5 minutes.

Finally, with a current of 1,000 amperes and 80 volts we may volatilize in 5 minutes 100 grammes of calcium oxide.

Magnesia.—Magnesia is less readily volatile than lime. Its boiling point is very near its point of fusion. As soon as the magnesia is melted it emits vapors which condense on the cold tube. This experiment is effected with a current of 360 amperes and 80 volts. This distillation is very rapid, if we employ currents of 1,000 amperes and 80 volts.

CONCLUSIONS.

In fine, at the high temperature produced in our experiments by the electric arc the elements hitherto regarded as the most refractory are volatilized. The most stable compounds of mineral chemistry disappear in the electric furnace either by dissociation or by volatilization. Nothing remains to resist these high temperatures except a series of new compounds, perfectly crystalline, of an exceptional stability, the properties of which we shall soon describe. These bodies are the metallic borides, silicides, and especially carbides.

Daubree has already shown that the carbon of all our present organic compounds was originally existent in the state of metallic carbides. The electric furnace seems to reproduce the conditions of that remote geological epoch. It is probable that such compounds exist on stars of high temperatures. We will add that at the same period the nitrogen would be met with in the form of metallic nitrides, while probably the hydrogen existed in great quantity in a free state in a complex gaseous medium containing hydrogen carbides.

* Bulletin de la Societe Chimique de Paris.—Chem. News.

A PTOMAINE FROM PLEURISY PATIENTS.

By A. B. GRIFFITHS, Ph.D., F.R.S.E., etc., Lecturer on Chemistry at the Central School of Chemistry and Pharmacy.

THE word "ptomaine" (from Greek ptoma) is no longer restricted to the substances derived from decomposing animal tissues, as ptomaines have been found in the excretions of the body during life, especially in pathological states; and it has been shown that diseases can be communicated by these substances in the entire absence of microbes. Gautier calls the substances produced in the system during life leucomaines, while he reserves the word ptomaine for those substances formed by putrefaction after death. But does it follow that the terms ptomaines and leucomaines should be considered as absolutely distinct? In the present state of our knowledge of these curious substances, this is not admissible. It is often in vain to try to trace rigorously where one series of "alkaloids" begins or the other terminates. In fact, it is extremely difficult, if not impossible, to draw the limits of the word ptomaine. As a rule the ptomaines are allied to the vegetable alkaloids; the majority of them contain carbon, hydrogen, nitrogen, and oxygen; some are, however, devoid of oxygen; and the ptomaine (or toxine, as Brieger would call it) to be described in this paper does not contain nitrogen. Many ptomaines have been isolated from urine in cases of infectious and other diseases (Luff, in British Medical Journal, July 27, 1889; Hunter, in British Medical Journal, July 12, 1890; and Griffiths, in Comptes Rendus de l'Academie des Sciences, Paris, tomes cxiii.-cxviii.; and Griffiths' "Manual of Bacteriology," Heinemann); and a few of the same ptomaines have been isolated from pure cultures of certain pathogenic microbes (Brieger, in Berliner klin. Wochenschrift, 1888; Virchow's Archiv., 1887 9; Berichte, xix., 3119; Griffiths, in Comptes Rendus de l'Academie des Sciences, Paris, t. cxiii., p. 656, t. cxiv., p 496, p. 1382, Bulletins de l'Academie Royale de Belgique, 3 e. s., t. xxiii., p. 840; and Griffiths' "Researches on Micro-Organisms," Bailliere).

The ptomaine described in this paper was extracted from urine of patients suffering from pleurisy, by the following method: a. A large quantity of urine was made alkaline by the addition of sodium carbonate, and then agitated with half its volume of ether. b. The ethereal solution (after standing) was filtered and agitated with a solution of tartaric acid. The tartaric acid combines with any ptomaine present, forming a soluble tartrate, and the tartrate solution forms the lower layer of the liquid. c. The tartaric acid solution (after being separated from the ether) was also made alkaline by the addition of sodium carbonate, and was once more agitated with half its volume of ether. d. The ethereal solution (after standing) was separated, and the ether allowed to evaporate spontaneously. e. The residue (after drying over sulphuric acid) was treated with water, an excess of pure calcium hydroxide added, and the mixture evaporated on a water bath. The residue so obtained was treated with chloroform and filtered. The filtrate (after evaporation) yielded the ptomaine in an isolated and a crystalline condition.

This ptomaine (which may be called "pleuriceine") is a white crystalline substance, with a slight hawthorn-like odor. It is readily soluble in hot water, and on cooling the solution deposits beautiful feathery crys-

tals. Concerning these crystals, Mr. W. J. Pope, F.C.S. (of the City and Guilds Central Technical College, South Kensington), who kindly investigated them for me, gives the following description: "On slowly cooling the hot, concentrated, aqueous solution, the substance separates in aggregates of colorless, transparent, rectangular plates, possessing a calcite-like luster. The crystals belong to one of the biaxial systems, and one of the optic axes emerges normally to the large faces of the plates. The extinction is straight, the double refraction strong, and the dispersion considerable." I may say, en passant, that I had not sufficient material for Mr. Pope to obtain the substance in measurable crystals, but he says that the foregoing qualitative description "is quite sufficient for the identification of the substance, and he can undertake to prove the identity of this ptomaine with any other product at any future time."

This ptomaine is precipitated by hydrochloric acid, after standing some time, as a white crystalline hydrochloride. Nessler's reagent gives with it a pale yellow precipitate; and after standing some time the precipitate darkens and becomes a brownish, the liquid appearing pinkish by transmitted light. The precipitate, on heating, is destroyed or redissolved, and the solution becomes colorless. Potassium ferrocyanide gives no precipitate at first, but on warming the mixture a white or pale yellow precipitate is produced, and after standing some time it becomes of a greenish hue. Ferric chloride gives a white precipitate with this ptomaine. Potassium cadmium iodide (Marme's test) gives a red precipitate; potassium-bismuth iodide (Dragendorff's test) produces a green precipitate; and phosphoantimonic acid gives a bluish precipitate. Phosphotungstic acid, after standing with the ptomaine solution for some time, throws down a white crystalline precipitate.

The following figures were obtained on the analysis of the ptomaine:

0·1580 grm. of substance gave 0·3338 grm. of CO_2 and 0·0724 grm. of H_2O.

	Found	Calculated for $C_5H_5O_2$
Carbon	57·44	61·79
Hydrogen	5·09	5·16
Oxygen	—	33·05

From the foregoing percentage composition, $C_5H_5O_2$ represents the formula of this new ptomaine. It is a poisonous substance, which readily kills mice and other small animals. It does not occur in normal urine; it is therefore produced within the body during the course of the disease (pleurisy).

In conclusion, I wish to take this opportunity of expressing my indebtedness to Messrs. W. J. Pope, F.C.S., W. L. Gadd, F.I.C., and E. A. Wagstaffe, Ph.D., B.Sc. (Vict.), who helped me with some of the work recorded in this paper.—Chemical News.

A SIMPLE WAY OF OBSERVING THE HARDNESS OF WATER.

PREPARE a solution of soap by heating 10 parts of pure soft soap in 250 parts alcohol of 55 per cent. Let the solution cool, and filter into a stoppered bottle for use

Test: Put 40 c. c. of the water to be tested into a 100 c. c. bottle. Fill a burette, graduated in tenths of c. c., with the soap solution. Commence by running in one-tenth c. c. (one-tenth c. c. means about two drops) at a time of the soap solution into the water tested, and shake the bottle violently after each addition, and continue this until the point were a permanent foam remains over the water in the bottle.

If the least soap solution is added to pure water, a permanent foam is at once formed. If water contains lime salts, the foam will disappear after each addition of soap and shaking until just that quantity is added which overcomes the power of the lime to dissolve the soap, when the foam remains permanent. By this means the hardness of water can be expressed in degrees.

One-tenth of a c. c. of soap solution added indicates 1 degree of "hardness," and is about equal to one part of calcium or magnesium carbonate (in a trifle more of the sulphate) in 100,000 parts of water:

	Degree of Hardness.
Pure water	= 0
Water + $\frac{1}{10}$ c. c. of soap solution	= 1° hardness.
" + 1 c. c. "	= 10° "
" + 2 c. c. "	= 20° "

Roughly, by addition of soap solution, the hardness of the water can be immediately seen.

The expression of hardness in degrees is used in French and German beet sugar houses.

The estimation of the amount of lime salts in water which is used for boiler purposes is, if well known, important. It is also of vast importance that the water used in diffusion sugar houses should be carefully tested, since the greater portion of the lime salts contained in the water which goes into the battery cells remains in the sugar products.

If the examination of water is made chemically, the lime is estimated as an oxalate, and the sulphuric acid as barium sulphate, and the remaining acids may be considered as hydrochloric and carbonic acids. This, however, means a full chemical analysis of the solids in the water, and is lengthy.—Walter Maxwell, in Louisiana Planter.

SOPHISTICATIONS OF FOOD.

OF 37,233 samples examined in Britain, 4,793 were condemned. In Holland, in six months, 398 samples, of which 148 were condemned.

In Rotterdam, of 20 samples of butter, 5 were found objectionable. The Reichert-Meissl value 18 was taken as the lowest limit. In Berne, of 13 butters, 8 were falsified or bad. Two samples of so-called "import-butter" gave Reichert-Meissl values of 4·8 and 9·4, and one of them had 17·87 degrees of rancidity.

Of 7 cocoa powders examined in Rotterdam, 2 contained extraneous starches, and in one of them ground cocoa shells were present in abundance.

Of the dried fruits examined at Rotterdam, all were objectionable, either as decayed or containing zinc. Copper sulphate was found in a sample of beef. Wiley (an American expert) found all peas imported from France cupriferous and urged their condemnation, in spite of the small quantity of this metal.

In Belgium spices have often been found objectionable during the present year Black pepper contained 30 per cent. of starch. Saffron was contaminated with 50 per cent. of heavy spar and honey. Another make contained vegetable fibers colored with acid magenta.

Mustard was mixed in one case with meal, in another with turmeric, and in a third with turmeric, sand, and a fatty oil.

At Rotterdam a sample of cinnamon was mixed with ground wood. Cloves were mixed with starch.

At Berne, among 8 samples of cloves 6 were condemned, of 15 ground peppers 12, and of 19 saffrons 13.

Of 500 samples of honey, 45 per cent. were pronounced impure by Wiley; of 4 examined by Schaffer, 2 were objected to.

Wiley detected artificial coffee beans, both new and burnt. At Berne artificial coffee beans were detected manufactured from acorns.

Wiley often detected samples of tea leaves which had been extracted and redried. Lam, of Amsterdam, detected the same fraud, and of 10 samples examined by Schaffer, 7 contained extracted leaves.—Chemiker Zeitung.

ON SOME ORGANOSOLS.*

By E. A. SCHNEIDER.

IT is well known that Graham succeeded in the course of his work on diffusion in substituting organic liquids for the water in colloidal solutions. I mention here only that he prepared colloidal solutions of silicic acid in alcohol, ether, and even in carbon bisulphide.† Similarly to his nomenclature for water soluble colloids—hydrosol for the water soluble colloid, hydrogel for the coagulated colloid—he formed names like alkosol and alkogel, glycerosol and glycerogel, etc.

After having investigated somewhat this field, it appears to me very probable that the water in colloidal solutions may be replaced by many organic liquids. Should we accept without reserve Graham's nomenclature, we should find it difficult to form in all cases clear and euphonious names. I propose, therefore, to retain the excellent expressions "hydrosol" and "hydrogel" for the water soluble and the water insoluble forms of colloids and to call the solutions of colloids in organic liquids "organosols," while adding the chemical formula of the colloid and that of the solvent in parenthesis. Graham's experiments on organosols have not been repeated, so far as I can make out from the existing literature. For this reason alone it appeared to me desirable to extend them to the large class of colloidal inorganic sulphides, which have become known only recently, and also to colloidal silver. The preparation of such solutions appeared to me also desirable, because we may hope that a detailed investigation of their physical properties will shed some light on the nature of solution.

Organosol Au_2S_3 (Ethyl alcohol).—Among the numerous known colloidal sulphides the best suited for the first experiments in this field appeared to be the colloidal sulphides of gold,‡ which have already been studied by me. They possess the advantage over other sulphides that they are not subject to oxidation on contact with the air, an advantage which should not be underestimated, if the length of time which dialysis requires is taken into account.

The organosol was obtained by dialyzing an aqueous solution of auroauric sulphide mixed with alcohol into absolute alcohol. To 50 c. c. of a solution which contained in the liter 1·514 grammes Au_2S_3 and only traces of impurities (prepared by the action of potassium cyanide on precipitated auroauric sulphide), 150 c. c. absolute alcohol were added; no sign of coagulation became visible. The mixture was poured into a parchment tube and the latter suspended in a tall narrow beaker which was filled with absolute alcohol. The dialysis was carried on under a bell jar which fitted air tight on a ground glass plate. If an attempt is made to dialyze the hydrosol of the sulphide into absolute alcohol without mixing it first with a sufficient quantity of alcohol, the contents of the dialyzers become coagulated and hardly any liquid is left in the dialyzer after the lapse of twelve hours, for the rapidity of diffusion of water through the parchment into absolute alcohol is much greater than the opposite movement.

After twenty-six days of dialysis, during which time the alcohol in the outer vessel was frequently renewed, a liquid was obtained which did not show any difference, so far as color and optical behavior are concerned, from the hydrosol of the auroauric sulphide.

The analysis of the organosol was carried out in the following manner: 100 grammes were distilled from a fractionating bulb at the temperature of the water bath; at the same time a stream of dry carbonic acid was conducted into the flask in order to accelerate distillation. The specific gravity of the distillate was determined very accurately by means of the pycnometer. The residue in the fractionating bulb was dissolved in aqua regia and the gold was determined in the usual way; 100 parts by weight of the organosol contained:

	Parts by weight.
C_2H_5OH	98·90
Au_2S_3	0·0676
H_2O	1·03
	99·99

Equal volumes of the hydrosol and of the organosol which contain the same quantity of auroauric sulphide do not show any difference in depth of coloration or transparency.

The organosol is very stable, apparently more stable than the hydrosol, which on standing a long time deposits sediment.

Organosol Au_2S (Ethyl alcohol).—Up to this time I have not succeeded in preparing a sufficiently concentrated organosol of aurous sulphide in alcohol; the probable reason is that the hydrosol was not sufficiently pure. It was possible to mix the latter in all proportions with alcohol, but on dialyzing such a mixture coagulation always took place. The strongest alcoholic solution which I obtained by mixing the hydrosol with alcohol contained 99 per cent. alcohol, but only 0·001 per cent. aurous sulphide. Its color was yet perceptibly straw-yellow and it appeared clear in transmitted as well as in reflected light.

Organosol Ag (Ethyl alcohol).—I have prepared the organosol of silver in ethyl alcohol according to two methods. It can be obtained easily and conveniently by the dialysis of the hydrosol into absolute alcohol.

The product of a twenty-seven days' dialysis was analyzed with the following results: 100 parts by weight of the organosol contained—

	Parts by weight.
C_2H_5OH	99·30
Ag	0·1746
H_2O	0·53

This organosol is completely opaque in layers 2 mm. thick. Diluted with a sufficient quantity of alcohol or water, it appears in transmitted light chlorophyl green with a bluish tinge; on further dilution the color becomes yellow-green. It is perfectly transparent in transmitted light; viewed by reflected light it appears violet-brown and decidedly turbid.

It is worth while to mention that on distilling off the alcohol, silver is deposited on the bottom of the fractionating bulb as a beautiful gold-colored mirror.

The succession of colors in the hydrosol, in the case of transmitted light, reminds one very much of Newton's rings, for here also the order proceeds from brown-red to blue-green, while the thickness of particles is probably increasing. This analogy, however, is incomplete, for we are dealing here not with the colors of thin plates, but at the most with diffraction phenomena.

As far as the color of the solid colloid is concerned it, can be explained by pure absorption. Still the peculiar correlation of the complementary colors—hydrosol, red-brown; solid mirror of the same, blue-white; organosol, green; solid mirror of the same, golden-yellow—is remarkable and needs further explanation.

If the probability is kept in view that it may be possible to explain the changes of color of the silver solution on the basis of well-known laws of optical physics, the assumption of allotropic modifications of silver, which has been made by Carey Lea, becomes unnecessary.

The organosol of silver in ethyl alcohol may be also prepared in another very easy manner, which is interesting because it illustrates the general application of the laws according to which colloidal solutions are formed.

If to the silver hydrosol, as it is obtained according to Carey Lea's prescription, absolute alcohol is added, coagulation begins as soon as a certain degree of concentration is reached. The black finely divided precipitate is now separated from the solution by means of a Pasteur filter. It settles on the walls of the latter as a crust with a beautiful bronze luster. This precipitate is soluble in water as well as in absolute alcohol, because the original impurities have been reduced to a minimum.*

Two portions of 100 c. c. each of an organosol which had been prepared in this manner were subjected to analysis. The silver was coagulated with hydrochloric acid in alcoholic solution.

Previous to analysis the organosol had been allowed to stand for two months, and a sediment had separated out.

The analysis gave the following results:

	I. Grammes.	II. Grammes.
Ag	0·1240	0·1225

Consequently a hundred parts by weight of the organosol contain, if we assume that the strength of the observed alcohol has decreased, owing to absorption of moisture from the air, to 99 per cent. by volume:

	Parts by weight. I.	II.
Ag	0·1552	0·1533

Starting from the alcoholic organosols, it appears to me possible to prepare many organosols of the inorganic sulphides and of silver.

CHEMICAL PROPERTIES OF THE MYDRIATIC ALKALOIDS.*

By THEODORE G. WORMLEY, M.D.

SEVERAL different alkaloidal substances or principles have been discovered as existing in the mydriatic plants; but it is now generally conceded, especially through the researches of Ladenburg, that these consist of three distinct isomeric bodies, having in common the formula $C_{17}H_{23}NO_3$, and named respectively atropine, hyoscyamine and hyoscine, the last named being found only in Hyoscyamus niger, associated with hyoscyamine. The substances formerly described as daturine, from Datura stramonium, and duboisine, from Duboisia myoporoides, are now considered to be identical with hyoscyamine.

Atropine, hyoscyamine and hyoscine are closely allied not only in their chemical composition, but also in their physiological effects and their general chemical properties, yielding much the same results with the ordinary reagents. According to Ladenburg, atropine fuses at 114° C., hyoscyamine at 108° C. In the free state, hyoscine forms a sirupy liquid, which, with acids, forms crystallizable salts. Other differences have been pointed out in regard to these principles, but these would rarely serve for discrimination in ordinary toxicological investigations.

In the following comparative examination of some of the tests for these substances, recent samples of the three alkaloids as prepared by Merck, Trommsdorff, and by Kahlbaum were employed. Only one preparation, however, of hyoscine (Kahlbaum's) was examined, this being in the crystalline state, as hydrochloride.

(1) Vitalis' Test.—This test, as is well known, consists in treating the solid alkaloid or one of its salts with a drop or two of nitric acid, evaporating to dryness on a water bath, and treating the cooled residue

* From Bulletin 113, United States Geological Survey.

† Ann. de Chim. et de Phys., 4 ser., 3, 1864.

‡ Berichte, XXIV., 2941.

* Compare article on the preparation of the pure hydrosol of silver, pages 99-101, this bulletin.

† From the American Journal of Pharmacy.

with a drop of a strong alcoholic solution of potassium hydroxide, when a deep violet coloration is produced.

On comparing the above samples of the three alkaloids, in equal but varying quantities, side by side, under this test, no appreciable difference was observed in the results. It has been stated by some writers that under this test atropine yields a yellow coloration, whereas hyoscyamine yields a purple color; but this difference did not exist in the preparations examined.

(2) Auric Chloride.—This reagent throws down from aqueous solutions of salts of the alkaloids, even when quite dilute, a bright yellow precipitate of the aurochloride of the alkaloid. The precipitate from hyoscine, being the least soluble of these gold salts, is notably greater in quantity, and it more promptly assumes the crystalline form than the precipitate from like solutions of either of the other two alkaloids.

If a drop of a 1–100 solution of the alkaloids be treated with a drop of the reagent, the hyoscine solution yields a very copious precipitate, and soon the mixture becomes a solid, confused crystalline mass. The precipitate from atropine stands next in quantity, that from hyoscyamine being least. No marked difference was observed in the color of the precipitates, even on spontaneous evaporation to dryness.

A drop of a 1–1,000 solution of the alkaloids gave with the reagent, very uniformly in the case of hyoscine, a precipitate which quickly formed crystalline lamina or leaves; while that from atropine formed minute granules, and that from hyoscyamine crystalline blocks or masses.

(3) Bromine Test.—As we have pointed out elsewhere, a solution of bromine in bromohydric acid throws down from solutions of atropine and of hyoscyamine, even when highly dilute, a yellow amorphous precipitate which is soon converted into characteris ic crystals, no marked difference being observed between the reaction of the two alkaloids. With an aqueous solution of hyoscine, the reagent produces a voluminous yellow precipitate which soon becomes converted into minute globules; these change to large yellow drops, which slowly dissolve to a colorless solution. In no instance were crystals obtained by the reagent from a 1–100 or more dilute solution of this alkaloid.

This reaction, therefore, serves to discriminate atropine and hyoscyamine from hyoscine, at least from the preparation under examination.

The bromine reagent may be very satisfactorily applied to atropine and hyoscyamine, and their salts, in the solid state. If a minute portion of either alkaloid be touched with a small drop of the reagent, it is immediately converted into a mass of crystals, consisting of rough needles, twig-like masses and bright yellow plates.

The residue from one drop of a 1–1,000 solution of the alkaloids yields with the reagent a mass of crystals of the usual forms; and the residue from a drop of a 1–10,000 solution gives a very satisfactory deposit of crystalline needles and granules.

This reaction, as in the case of solutions of the alkaloid, will manifest itself in the presence of comparatively large proportions of foreign matter. Thus, if a drop of a 1–1,000 solution of the alkaloid be treated with a drop of ordinary urine, and the mixture evaporated to dryness, the residue will yield, under the reagent, a very satisfactory crystalline reaction, although the proportion of urine solids to the alkaloid present is about 50 : 1. Crystals may be obtained from even a much less quantity of the alkaloid mixed with this amount of urine solids.

If the bromine reagent be applied to a minute drop of a sirupy solution of hyoscine, it is immediately converted into a mass of reddish-yellow globules, which soon change to bold groups of faintly yellow crystals, these being quite different in form from the crystals obtained from the other two alkaloids.

The residue from a drop of a 1–100 solution of hyoscine yields, under the reagent, a mass of yellow globules, which soon become converted into groups of bold crystals. From the residue from a 1–1,000 solution of this alkaloid no crystals were obtained, the precipitate consisting alone of oily drops.

(4) Picric Acid.—A drop of a 1–100 solution of atropine, when treated with a drop of an alcoholic solution of this reagent, yields a voluminous yellow precipitate, which slowly becomes converted into minute yellow drops. If, however, the mixture be stirred with a glass rod, it quickly yields beautiful groups of yellow crystals, as figured in Micro-Chemistry of Poisons, Pl. xiii., Fig. 1.

A drop of a similar solution of hyoscyamine yields, with the reagent, results not to be distinguished from those from atropine.

A like solution of hyoscine gives, with the reagent, a yellow precipitate, which remains amorphous; but on stirring the mixture it slowly becomes, on standing, a dense mass of fine, feathery or plumose crystals, markedly different in form from the crystals of the preceding alkaloids. These crystals are less readily formed than those from either atropine or hyoscyamine.

(5) Platinic Chloride.—Under the action of this reagent, when applied to somewhat strong solutions, no marked difference was observed between the three alkaloids.

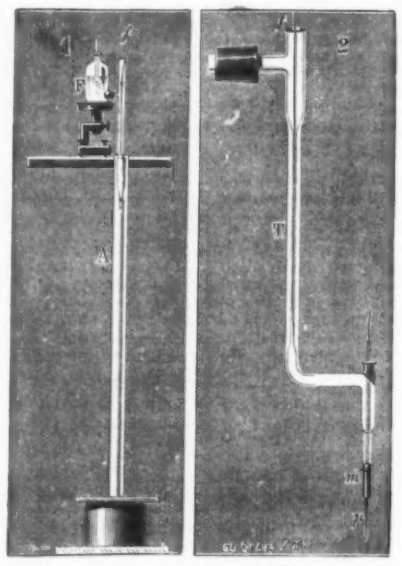
THE FALL OF A DROP OF WATER.

THERE is no phenomenon, as insignificant as it may be, that does not yield an abundant harvest of facts and is not worthy of exercising the sagacity of investigators. It is this idea, I think, rather than researches upon a technical difficulty, that guided the promoters of an interesting competition proposed by the Swiss Review of Photography, of Geneva. It is a question of catching and fixing by photography the fugitive form of a drop of water falling under determinate physical conditions made known in the programme of the competition.

To the ordinary mind, the subject may appear as if selected by chance in order to lead with much trouble to a result of trifling interest. But upon looking into it more closely, we shall see the question broaden, and expand if I may so express myself, and become exceedingly attractive. We should not have liked to rob amateur photographers of the pleasure of investigating the peculiarities of the phenomenon that was proposed for their study, and that is the reason why we have awaited the termination of the competition before giving the details that follow. The study of the fall of a drop of water has already been the occasion of numerous labors.

When a drop of water increases in size at the extremity of the tube that supports it, it assumes a well known pleasing form that may be reproduced in very amplified dimensions by inflating a soap bubble with illuminating gas. The antagonistic forces that are in play are the same in both cases in the direction of the thrust. The lower half of the bubble is sensibly hemispherical and very near its form of equilibrium. The upper part, on the contrary, is elongated by virtue of that mysterious force called superficial tension. The drop is suspended like a film that suddenly rends and closes at its upper part. These phenomena are very curious ones for the physicist to study.

The definite form of equilibrium (the sphere) immediately tends to establish itself, and the drop undergoes a series of oscillations of decreasing amplitude whose nature is itself constantly modified.



FIGS. 1 AND 2.—FALL OF A DROP OF WATER.
1. Lenard's apparatus for the study of drops of water.
2. Details of the tube.

However difficult the problem of the oscillation of a drop may appear, it is now fully solved, thanks to Lord Rayleigh, one of the masters of modern physics, who has devoted to it an admirable series of studies. Developing the expression of the meridian curve of the drop in a formula, he finds the expression of its duration of oscillation as a function of the density of the liquid and of its superficial tension.* The form of the drop is in the first place complicated, but it is soon reduced to an ellipsoid the duration of whose oscillation is proportional to the power $\frac{3}{2}$ of the radius.

A drop of water that undergoes a complete vibration in one second has a diameter of 5 centimeters. With a diameter of 1 millimeter the duration of the oscillation is reduced to $\frac{1}{125}$ of a second. The researches of Savart and of Magnus upon the oscillations of drops of water are classical, but it is in recent years only that it has been possible to apply photography to the solution of this interesting problem.

In 1887 Mr. Lenard published in Wiedemann's Annalen an account of some researches which had for their object the determination of the superficial tension of liquids by the fall of a series of drops of which the duration of oscillation was determined. Mr. Lenard's memoir contains some interesting facsimiles of a few of the most characteristic of his photographs. We reproduce one of them in Fig. 3. The experimental conditions of the problem are very clearly set forth in this memoir, a reading of which cannot be too highly recommended to those whom a repetition of the same experiments interests.

The tube whence the drops escape is supplied by a Mariotte flask, F (Fig. 1), which regulates the discharge, and which terminates in a small cylinder of tissue paper, m (Fig. 2), and carries at its lower part a fine point, p, formed of a barb of an ear of rye that has been previously well washed. This point guides the drop in its fall and abandons it less abruptly than the liquid ligament at the moment of its rupture. The drop thus takes on at once a motion of elliptical oscillation, and there are avoided those odd forms of the beginning that complicate the phenomenon and render the determination which Mr. Lenard had in view more difficult. The drop falls in the interior of a tube, A (Fig. 1), which protects it against the motions of the air. The discharge of the apparatus is regulated by a glass rod, f, that is inserted in the exit channel, T.

The photographing can be done in any phase whatever of the motion of the drop by the aid of the instantaneous light of an electric spark. It is possible, even, to illuminate all the successive drops at the same place and in the same period, so that the phenomena shall be reproduced indefinitely. To this effect it suffices to employ the drops themselves for the production of the spark.

The interrupter of the primary circuit of a Ruhmkorff coil is formed of quite a long spring that carries at one extremity a small piece of cork upon which the drops fall. The spring is provided with a platinum contact which presses gently upward against a plate of amalgamated copper. Every drop that strikes the disk of cork produces a short interruption, during which the bobbin gives a spark. Upon interposing a plate of ground glass between the bobbin and the drop, we shall see the latter detach itself in black upon a white ground; and, when the apparatus is properly regulated, micrometric measurements of the drops that succeed one another at the same place may be made, just as if the same drop were remaining indefinitely suspended in the air. Of course, such measurements should not be made from too great a height of fall.

The exactitude of the values of the superficial tension deduced by Mr. Lenard from the duration of oscillation of the drops shows that Lord Rayleigh's theory is remarkably approximate. Yet it is not entirely complete in the case of the drops that fall, as we shall presently see.

The observation of drops illuminated by an electric spark or by means of a revolving disk gives rise to some curious illusions. When the sparks are not illuminated by the drops themselves, it is possible to give them at will a slight advance or a slight retardation. Each drop will then be seen a little back or a little in front of the position that was occupied by the preceding one. They appear to fall in oscillating with a wonderfully slow motion, or even to rise again toward their source.

In a work that we have more than once had occasion to cite in this place, Mr. C. V. Boys gives a series of images of a drop of water falling from an orifice, and that were obtained with the same drop by means of a chronophotographic apparatus, and through a very simple artifice. The drop, which is very large, falls into a liquid with which it does not mix. Its motion is greatly retarded, but it preserves its exact character. The images, which correspond to an entire period, are obtained upon the circumference of a plate, and can be mounted in a phenakisticope, which gives a perfect illusion of reality.

We have said that the mathematical theory established by Lord Rayleigh is applicable only approximately to drops that fall. In fact, the latter, in passing into the surrounding medium, experience a friction

FIG. 4.—DIAGRAM OF THE VORTICES THAT FORM IN A FALLING DROP OF WATER.

which is shown by a tendency to form a vortex, as shown in Fig. 4.

The drops of water energetically resist this motion, which has for a consequence the formation of a fresh surface at their lower part. Now we know that the least contamination reduces the superficial tension of water. The continuous replacing of the surface of the water can be effected only with an expenditure of work for which, as a general thing, friction does not suffice. The same is not the case with other liquids, which show, even in the air, a very manifest tendency to form vortices. The latter, moreover, are obtained with the greatest facility by causing the drops to fall into a liquid with which they mix. For example, beautiful rings are obtained by allowing water to fall into milk, alcohol, and a large number of aqueous or alcoholic solutions. But, as has been shown by Messrs. J. J. Thomson and H. F. Newall, such rings are formed only under certain conditions of height of fall, corresponding to the entrance of the drop into the lower liquid at a certain phase of its oscillation. In fact, if we gradually raise the tube of escapement, we shall see the rings form and then disappear alternately, the periods of formation being separated by equal augmentations in the duration of the fall.

The accessory results of these experiments are very interesting. We immediately remark in particular that the regular rings fall with a great velocity to the

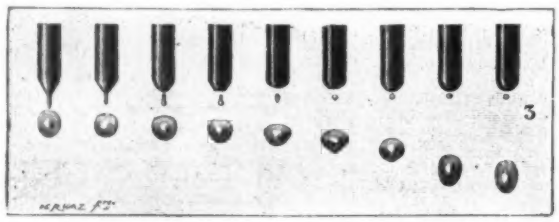


FIG. 3.—SUCCESSIVE FORMS OF A DROP OF WATER LEAVING ITS ORIFICE.

* In Lord Rayleigh's calculation, the meridian curve is expressed, in polar co-ordinates, by a series of spherical functions. The first represents the sphere and the second an ellipsoid, and the following express the various irregularities of the form. Upon designating the order of any one of these functions by n, the duration of the oscillation that corresponds to it will be:

$$t_n = 2\pi \sqrt{\frac{r^3\delta}{n(n-1)\ (n+2)\tau}}$$

r designating the radius of the sphere, δ the specific mass of the liquid, and τ the superficial tension. The motions become deadened so much the quicker in proportion as they correspond to a higher value of n.

Upon making n = 2 in the preceding formula, we find:

$$t = \pi \sqrt{\frac{1}{2}\frac{r^3\delta}{\tau}}$$

bottom of the vessel, while the drops stop midway. We conclude from this that the annulax vortex is a form very favorable to progression.

In the subject under consideration there is more than one detail to be cleared up. As the duration of oscillation of the drops is a function of the superficial tension, every cause that modifies the latter acts likewise upon the duration of oscillation. It suffices, for example, to open a bottle of alcohol or ether in the vicinity of the apparatus in order to modify the phenomenon immediately.

Does electricity exert an action, as some authors think? Do the drops that closely follow one another act upon each other in such a way as to modify the velocity of their fall? What is the influence of a vertical wall in the vicinity of the drops? Such are, among a large number of questions that are proposed, three of the most pertinent. The study of them has been prosecuted after a manner, but it can be entered into more deeply. The second, in particular, is of a nature to furnish us with data relating to the much-debated role of bicycle trainers. As may be seen, the contest opened by the Swiss Review of Photography embraces a very vast domain, and the amateurs who have taken part in it have had only the embarrassment of choice to develop such or such a point.—C. E. Guillaume, in La Nature.

PRONUNCIATION OF WORDS IN SINGING.

By L. B. PARSONS.

THE singer who aspires to become a church soloist should have, in addition to a pleasing voice under good control, the art of pure and distinct enunciation. The lack of it is simply inexcusable, as it may be acquired in a very short time. The mistaken idea seems to prevail that the English language is unmusical and difficult to articulate in singing, many claiming that the Italian is much easier to acquire. The rules that govern Italian words should govern our own, and by Italianizing our vowel sounds our own language may become much more musical both in speech and song. Musical elocution in different keys is something of an art, but the organs of speech may be so trained that it will be a pleasure to sing our own language.

Every vowel should be sung with equal ease, and never should the word be sacrificed for the tone, as is so often the case, for the vowel should be a part of the tone. Our English vowels, as commonly pronounced, have double sounds, as ā, pronounced much like ā-ee; o, like o-oo; i, i-ee; and u, e-u. In the more cultured these are less noticeable; for one who has a knowledge of at least one other language than his own is more apt to have a better appreciation of the pronunciation of words.

The great Lamperti could never rest until he had completely changed the vowel sounds of his English-speaking pupils. To obtain purity and evenness of vowel sound, practice should be given with one breath on a single tone, using the vowel sounds a, e, i, o, u, ä; also the syllables, in one breath, do, re. me, fa, etc. These exercises should be sung on single tones as high and as low as the voice can reach with ease. When this can be done without effort as high as the voice can reach, the pronunciation of words in singing becomes a simple matter. A particular point to be emphasized regarding consonants is that they be attacked quickly, with precision, and instantly joined to the vowel. We can all recall singers who emphasize the last consonant of a word so vigorously as to make an extra syllable of the word, making home sound like home-a; sweet, sweet-a, and many others equally ridiculous.

A slight rolling of the r at the beginning of a word is often effective, but it must be done delicately. In the words heart and Lord a rolled r makes them hear-r-ut and Lor-r-ud, completely spoiling the character of the words.

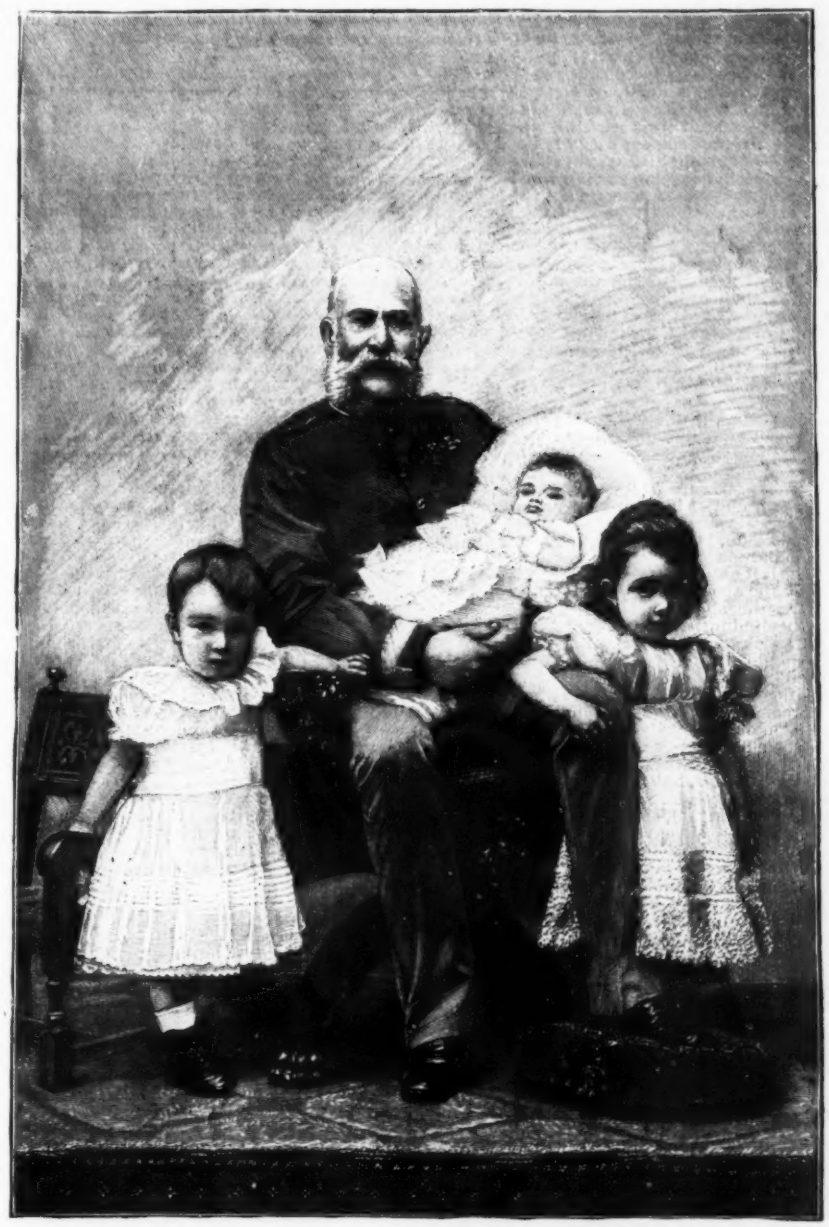
Sacred song calls for the best enunciation, as the sentiment of an anthem or hymn is the all-important thing, and the more perfectly it can be expressed the more does it become a part of the service. Sacred song also calls for truest art and sincerity of feeling, and the choir soloist who resorts to all sorts of embellishments and mannerisms (sometimes falsely called art) to conceal a lack of culture and real feeling is not in the right place. The personality of the singer should be hidden, and an endeavor made to interpret and convey the idea contained in the hymn to the hearts and minds of those who listen.

I will mention a few of the words most commonly mispronounced in singing by those who would hardly speak them in the same way: The words late (often pronounced la-eet), child (choild and chee-ilde), mercy (murcy), Shepherd (Shuppud), glory (glo-oo-ry and glary), King (Keeng), mine (mi-ene and moine), name (na-eeme), is (ees), etc. These are but a few of the long list. Experiment with the little words yes and no, and see if they do not sound like ye-us or ya-a-s, and no-oo. We drawl out our vowel sounds so unnecessarily. It is not merely distinct enunciation that we should work for, but the best and most refined, and to that end it will be seen that we must change the shape of our vowels. Too much can hardly be said on this point. As an illustration of how to obtain the best pronunciation of a word, we will take the one that heads this list. The lā should be taken with a smiling position of the lips, holding mouth and chin perfectly quiet, then quickly finishing with the consonant, making the word sound exactly as if spelled lāt. To change position of the mouth until a syllable is finished, is to spoil the word. Take the word no. Prepare or round the lips as for whistling, and speak or sing the word quickly without allowing the lips to change even slightly, and notice the difference between a perfectly round o and a double one.

If we will only borrow from the Italian its perfect vowel sounds, as was said before, we need no longer complain that our language is unmusical. Our words will not have an affected sound, but will grow refined both in speaking and singing. When Mr. Max Heinrich sings "Lord God of Abraham" from "Elijah," and pronounces the last word Ah-brah-hahm, we can forgive him, remembering that the a would have just that sound in his language; but it is not in good taste for an English-speaking person to imitate him in that respect, as it should be our aim always to sing a word as it is correctly spoken in our own language. This is always a safe rule to follow. Imitation of any one should be avoided, for even great singers sometimes err; but the greatest have always "dared to be true and simple." Let us remember that all true art is delicate and simple; and let us, church singers, strive for simplicity of style, for genuineness of feeling, and for an intelligent appreciation of our work, avoiding all mannerisms and embellishment.—The Outlook.

THE EMPEROR OF AUSTRIA AND HIS GRANDCHILDREN.

THE Emperor Franz Josef I., whose happy reign has lasted for nearly half a century, ascended the throne while still a youth, in the stormy times of the revolution. He passed through many dark days, but he displayed great perseverance and determination, devoting himself to the duties of his high position as chief officer of the state. This, however, has not made him forgetful of the joys and duties of a man of family. He is nowhere happier than when surrounded by his children and grandchildren, and, therefore, it is a satisfaction to see such a photograph as the one lately taken of the Emperor and his grandchildren. We publish a copy of this photograph, for which we are indebted to our worthy contemporary, Ueber Land und Meer.



THE EMPEROR OF AUSTRIA AND HIS GRANDCHILDREN.

RETIREMENT OF GENERAL HOWARD.

GENERAL HOWARD having reached the age of sixty-two is now retired from active service, such being the law. The Secretary of War in general orders announces the fact as follows:

"By direction of the President, the retirement from active service this day, Nov. 8, 1894, by operation of law, of Major General Oliver O. Howard, under the provisions of the act of June 30, 1882, is announced.

"General Howard entered the Military Academy in 1850, and was graduated therefrom among the honor men of his class in 1854. He was thereupon appointed in the ordnance department, and, after attaining the grade of first lieutenant, resigned his position in the army in June, 1861, upon the outbreak of the late war, to accept a commission as colonel of the 3d Maine Volunteers. He was promoted to be brigadier general of volunteers in September, 1861, and major general of volunteers in 1862. He served in the field continuously during the war, and was engaged in thirty-five combats and actions and many skirmishes. At Fair Oaks, Virginia, he lost his right arm. For distinguished bravery in this action he has received a medal of honor. The thanks of Congress were tendered to him for skill and heroic valor at Gettysburg. He became a corps commander in 1863 and was assigned to the command of the Army of the Tennessee in 1864. In the campaign of 1864 he was again wounded. He was appointed from the volunteers a brigadier general in the permanent establishment in 1864, and was promoted to be major general in 1886. He received the brevet of major general 'for gallant and meritorious services in the battle of Ezra Church, and during the campaign against Atlanta, Georgia.' While commander of the Department of the Columbia, he led the troops in person, in 1877, in a campaign against the Nez Perces Indians, and, in 1878, against the Bannocks and Piutes. He was, later, superintendent of the United States Military Academy at West Point, and afterward in turn commander of the Department of the Platte, of the Division of the Pacific and of the Division of the Atlantic. He retires from active service as commander of the Department of the East.

"Major General Howard's long, varied, and distinguished career has been characterized by marked ability in the command of troops and great gallantry in action; by unselfish patriotism and broad philanthropy. He has deserved the gratitude of his country-men and the rest provided by law after the close of a long and faithful military service."

A NEW TREATMENT FOR ERYSIPELAS.

By W. V. GAGE, M.D., McCook, Neb.

AT the risk of being assailed after the publication of this article with numerous letlers disputing my claim to originality in the method of handling the above named disease, I beg leave to call your attention to the treatment of erysipelas with the wet carbolic acid dressing. The treatment, as far as I know, is original; but I am more than willing that you should demonstrate to me that it is in no way new. Every physician has often experienced a conflict with erysipelas, and has probably many times arrived at the conclusion that his local applications did harm, not much good or were absolutely inert. Strumpel says: "The chief indications for treatment will be to check the unceasing advance of the disease; but, unfortunately, the means recommended for this purpose too often fail."

Iodine painted over the healthy skin at the border of the inflammation seldom arrests the progress of the local manifestation; and the old fashioned method with the nitrate of silver pencil is certainly as barren of results. In regard to internal medication, iron has, no doubt, been exhibited more than any other one medi-

cine. Probably no one, however, can state that he has noted any marked diminution in the severity of the disease under the influence of its administration. The same may be said of camphor, benzoate of soda and salicylic acid.

In the treatment of erysipelas with the wet dressing I have practically discarded internal medication, treating the disease as a local manifestation, which it certainly is; and only in cases where the patient has been treated in a previous attack by the use of both local application and internal medication, have I given some placebo "for the blood." I might add, however, that I have employed sulfonal for sleeplessness and delirium in some cases with marked results. For the cure of the disease I rely wholly, however, upon the local use of the wet five per cent. carbolized dressing. I make my own dressing from the bleached cheese cloth, and the method employed for the preparation of this gauze is so familiar as to need no repetition here. I use a dressing of my own preparation, as the manufactured article which we get in the shops is too dry for the purpose, while that which I keep in my office is put up in a large earthen crock and covered with a five per cent. solution of carbolic acid. The treatment can, of course, be applied to any case of erysipelas, but we will take, for example, a case of the facial manifestation of the disease. If the area of inflammation has encroached upon the line of the beard, the face should be shaven, as should the head, if the region of the hair be involved. I have found it best, even though the eyes are not yet affected by the disease, to close them and place over each one a fluffed pledget of the wet gauze. If the ears are involved, a small portion of the dressing should be placed back of each one, so that they shall not be pressed against the head by the bandage which is to be applied. Now apply the main dressing, which should envelop the head and face, including all parts which have a tendency to show the blush of the extending disease, being careful to let the dressing extend over the area of redness in all directions. Over the dressing a sheet of rubber tissue or oiled silk should be placed, the edge of the protective lapping well over the edge of the gauze. A bandage is now applied to hold the dressing in place. Care should, of course, be taken to so fix the dressing that the mouth and nasal cavities shall be free, although the eyes are to be covered. You have now converted your patient's head into an object somewhat resembling an Armour ham, but he feels better at once, as the gauze has by mere contact removed a considerable amount of heat from the diseased area. This dressing should be allowed to remain on for twenty-four hours, when it is to be removed and replaced by a similar one. I think, if you have never employed a like treatment, that you will be surprised at the marked diminution in the heat and redness over the area covered by the dressing, even after the first twenty-four hour period. The dressing is to be reapplied as long as the least suspicion of redness of the skin remains.

Compare the last case treated by you with the first one treated by the above method, and notice the difference. Mark the shortening in the course of the disease and the diminution of all disagreeable symptoms. It is absolutely essential that all signs of inflammation should disappear before the dressing is removed for good, as you will otherwise often be disappointed to notice a return of the disease which you had supposed cured. Better a day too long in a bandage than a repetition of the trouble. In order to satisfy myself as to the efficacy of the treatment, I have, after applying the dressing for twenty-four hours, removed it and left the case without treatment for a short period, on the return call finding, instead of the soft, pale, moist surface, the hot, tense, dusky skin of well developed erysipelas. I have up to date handled eleven cases of the disease after the manner set forth above, and have yet to be disappointed in a single instance. The cases have included, besides the facial type of the disease, three cases of traumatic erysipelas, and I am inclined to think that, if anything, the success of the treatment was more fully demonstrated in the last named cases than in the so-called idiopathic variety. I would like to receive a report of cases in which there has been a failure to effect a prompt cure after pursuing the wet dressing treatment.—Medical Record.

MODERN DEVELOPMENTS OF HARVEY'S WORK.*

By Dr. T. LAUDER BRUNTON, F.R.S.

THIS annual meeting in memory of Harvey is usually associated with feelings of pleasure and happiness, for it was intended by its immortal founder to commemorate the benefactors of the College and to encourage good fellowship among us.

Such commemoration of those who have benefited the College in the past, although it necessarily recalls many who have passed away, is, notwithstanding, on ordinary occasions pleasant instead of painful, because the feeling of loss through their death is completely overpowered by the recollection of the good they have done in their lifetime. To-day the case is very different, for the first thought that must needs occur to every one present here is that on this occasion last year our late president showed for the first time what seemed to be imperfect fulfillment of his duty to the College by being late in his attendance at the meeting. Perhaps nothing else could have shown more clearly his deep concern for the welfare of the College and his thorough devotion of every faculty of mind and body to its interests than the fact that no duty, no pleasure and no press of occupation could tempt him to leave one iota of his work in the College undone. The only thing that did keep him back was the hand of death, which, although at the last meeting he and we knew it not, was already laid upon him. Though his death was less happy than that of the great Harvey, inasmuch as he lingered on for days instead of hours after he was first struck down, yet their deaths were alike in this respect that, up to the time of the fatal attack, each was in the full possession of his faculties, each was in the enjoyment of his life. Like Radcliffe and Mead, like Halford and Baillie, and like many other distinguished fellows of this College, the greatness of Clark is to be estimated not by the published works which he has left behind, but by the influence he exerted on his contemporaries. For the very estimation in which his professional skill was held led to his whole time being taken up in giving advice and prevented him from having the leisure to work out or record the results of the pathological and clinical observations which both his youthful publications and his later career showed him to be specially fitted to make. I might say very much more about him, but it has already been said much better than I could possibly do it by yourself, Mr. President, in your annual address, and in the eloquent and heart-stirring words which you addressed to the College on the occasion of your taking the presidential chair rendered vacant by the death of Sir Andrew Clark.

But while we are saddened to-day by the death of our late president, we hope to be gladdened by the presence among us again of one whom we all reverence not only as a former president of this College, but as one of the greatest leaders of clinical medicine in this century, Sir William Jenner. Like Harvey, Sir William Jenner is honored by his College, by his country, by his sovereign and by the world at large. In times of trial and danger, the lives of the royal children were committed to the keeping of Harvey by his king; and to-day the care not only of her own life, but of that of her nearest and dearest, is committed to Sir William Jenner by his sovereign, in the full and well-grounded assurance that in no other hands could they be more safe.

The great clinician, Graves, wished to have as his epitaph, "He fed fevers;" but Jenner has advanced much beyond Graves, and, by showing us how to feed the different kinds of fevers, has saved thousands of valuable lives. To-day this College is acknowledging his right to rank with Sydenham, Heberden, Bright and Garrod, by bestowing upon him the Moxon medal for clinical research. In numbering Sir William among its medalists, the College honors itself as well as him, and in acknowledging the great services he has rendered, it is, on this occasion, acting as the mouthpiece of the medical profession, not only in this country, but in the world at large.

It was with the wish to keep green the memory of the benefactors of the College that this oration was instituted by Harvey, and not at all with the intention that it should be devoted to his own praise. But Harvey stands out so high above all others, that it is only natural that in the numerous orations which have been yearly given before the College of Physicians, the subject matter should have been, to a great extent, confined to a consideration of Harvey and his works. On looking over many of these orations, I find that everything I could say about Harvey, his person, his circumstances, his character and his works, has already been said so fully and eloquently that I could not add to it anything further, nor could I hope to express it even so well. I purpose therefore to consider to-day some of the modern developments of Harvey's work, more especially in relation to the treatment of diseases of the heart and circulation. There is, I think, a certain advantage in this also, inasmuch as one is apt by considering Harvey's work only as he left it, to overlook the enormous extent to which it now influences our thoughts and actions, and thus to comprehend its value very imperfectly.

As he himself says: "From a small seed springs a mighty tree; from the minute gemmule or apex of the acorn, how wide does the gnarled oak at length extend his arms; how loftily does he lift his branches to the sky; how deeply do his roots strike down into the ground!" *

How very minute is the gemmule, from which has sprung everything that is definite in medical science, for this gemmule is no other than the idea which Harvey records in these simple words: "I began to think whether there might not be motion as it were in a circle."

Out of this idea has grown all our knowledge of the processes of human life in health and disease, of the signs and symptoms which indicate disease, of the mode of action of the drugs and appliances which we use, and the proper means of employing them in the cure of disease. In the works that have come down to us, we find that Harvey developed his idea physiologically in several directions. He discussed its application to the absorption and distribution of nourishment through the body, the mixing of blood from various parts, the maintenance and distribution of animal heat and excretion through the kidneys. How far he developed it in the direction of pathology and therapeutics we do not know, as the results of his labors on these subjects have, unfortunately, been lost to us by the destruction of his manuscripts during the civil war.

We are proud to reckon Harvey as an Englishman by birth, but he is far too great to belong exclusively to any country; men of various nations and scattered all over the face of the earth acknowledge him as their teacher, and have played or are playing a part in developing his discovery in its various branches of physiology, pathology, pharmacology, semeiology and therapeutics. Americans, Austrians, Danes, Dutchmen, French, Germans, Italians, Norwegians, Russians and Swedes have all shared in the work, and so numerous are they that it would be impossible for me to name them all. Stephen Hales, however, deserves special mention, for he was the first to measure the pressure of blood in the arteries, and the resistance offered to the circulation of the blood by the capillaries was investigated by Thomas Young, a fellow of this College, who ranks with Harvey, Newton and Darwin, as one of the greatest scientific men that England has ever produced, and whose undulatory theory has been as fertile of results in physics as Harvey's idea of circulation has been in physiology and medicine.

Harvey's desire that those who had done good work should not be forgotten was founded upon his knowledge of mankind, and of the tendency there is to forget what has already been done by those who have gone before us. The opposite condition often prevails, and the past is glorified at the expense of the present. But sometimes the present is wrongly glorified at the expense of the past, and past work or past benefits are forgotten.

Good examples of this are afforded by physiological views regarding the action of the vena cava and pulmonary veins and the causation of the cardiac sounds. Harvey appears to have thought that the vena cava and pulmonary veins were simply dilated passively by the passage of blood into them; but the fact that they possess a power of independent pulsation was known to Haller,† and was brought prominently forward by Senac,‡ who regards the vena cava as the starting point of the whole circulation. He says: "The vena cava is therefore the first motor cause which dilates the cavities of the heart; it fills the auricles and extends their walls in every direction."

These observations appear to have been almost forgotten until they were again made independently a few years ago,‡ and in one of the latest and most accurate physiological treatises which now exist the description of the cardiac cycle is nearly the same as that given by Senac. "A complete beat of the whole heart, or cardiac cycle, may be observed to take place as follows:

"The great veins, inferior and superior venæ cavæ and pulmonary veins are seen, while full of blood, to contract in the neighborhood of the heart; the contraction runs in a peristaltic wave toward the auricles, increasing in intensity as it goes."§

The pulsation of these veins, however, cannot be a constant phenomenon, or it would have been noticed by such a keen observer as Harvey.

The sounds of the heart were discovered by Harvey, or at least were known to him, for he speaks of the sound caused in the œsophagus of the horse by drinking, and says: "In the same way it is with each motion of the heart, when there is a delivery of blood from the veins to the arteries that a pulse takes place and can be heard within the chest." This observation remained, as far as we know, without any further development until the time of Laennec, who introduced the practice of auscultation; but it was a fellow of this College, Dr. Wallaston,‖ who first discovered that the muscles during contraction give out a sound; and although many observations were made regarding cardiac murmurs by Corrigan, Bouillaud and Piorry, it was chiefly by fellows of this College, Dr. Clendinning, Dr. C. J. B. Williams and Dr. Todd, that the question was finally settled, and the conclusions at which they arrived are those now accepted as correct, viz., that "the first or systolic sound is essentially caused by the sudden and forcible tightening of the muscular fibers of the ventricle when they contract; and that the second sound which accompanies the diastole of the ventricle depends solely on the reaction of the arterial columns of blood in the semilunar valves at the arterial orifices."¶

Yet in recent discussions regarding the origin of cardiac sounds, little mention has been made of the work of this committee; and, indeed, I first learned of the value of the work from a German source, Wagner's "Handworterbuch der Physiologie."

The importance of these observations in the diagnosis of heart disease it would be hard to overestimate. But diagnosis alone is not the aim of the physician, whose object must be to prevent, to cure, or to control disease. A knowledge of physiology may greatly help us to prevent disease, not only of the heart and vessels, but of every member of the body. The control and cure of disease may also be effected by diet and regimen, but it is undoubtedly in many cases greatly assisted by the use of drugs, and is sometimes impossible without them. Harvey knew that drugs applied externally are absorbed and act on the body,** so that colocynth thus applied will purge, and cantharides will excite the urine; but the action of drugs when injected into the blood appears to have been tried first by Christopher Wren, better known as the architect of St. Paul's than as a pharmacologist. According to Bishop Spratt, "He was the first author of the noble anatomical experiment of injecting liquors into the veins of animals, an experiment now vulgarly known, but long since exhibited to the meetings at Oxford, and thence carried by some Germans, and published abroad. By this operation divers creatures were immediately purged, vomited, intoxicated, killed, or revived, according to the quality of the liquor injected. Hence arose many new experiments, and chiefly that of transfusing blood, which the Society has prosecuted in sundry instances, that will probably end in extraordinary success."††

The method originated by Wren, of injecting drugs into the circulation, was skillfully utilized by Magendie for the purpose of localizing the particular part of the body upon which the drugs exerted their action, and he thus conclusively proved that the symptoms produced by strychnine were due to its effect on the spinal chord. His experiments showed that the rate of absorption from various parts of the body varied enormously, and through the teaching of Christison, led to the introduction into practice by Dr. Alexander Wood of that most useful aid to modern therapeutics, the hypodermic syringe.

The first quantitative experiments on the effect of drugs upon the circulation were made, to the best of my knowledge, by James Blake in 1844, in the laboratory of University College, at the suggestion of the late Prof. Sharpey, with the hæmodynamometer of Poiseulle, which had then been recently introduced.

In speaking about the work of Blake and Sharpey, who are both dead, one requires to use the greatest care not to unduly detract from the merit of one by ascribing more to the other; but those who knew Prof. Sharpey's enormous range of knowledge, his readiness to put it all at the disposal of others, and the influence he exerted upon all who came in contact with him, as well as his unselfishness in making no claim whatever to what was justly his due, will at once recognize how greatly Blake was indebted to Sharpey. More especially is this the case when we consider that, although the credit for the observations themselves belongs to Blake, yet after the impetus

* The Harveian Oration, delivered at the Royal College of Physicians, on October 18, by Dr. T. Lauder Brunton, F.R.S.—Nature.

* "The Works of W. Harvey," Sydenham Society's edition, p. 330.

* Haller: "Elementa Physiologiæ," 1757, tome 1, pp. 410 and 399.

† Senac: "De la Structure du cœur," livre iv., ch. iii., p. 24.

‡ Proc. Roy. Soc., 1876, No. 172.

§ M. Foster: "Text-book of Physiology," 6th ed., part i., ch. iv., p. 231.

‖ Wollaston: Phil. Trans., 1810, p. 2.

¶ Report of Committee consisting of C. J. B. Williams, R. B. Todd and John Clendinning; "Brit. Assoc. Rep. for 1836," p. 155.

** "The Works of William Harvey," Sydenham Society edition, p. 72.

†† "The History of the Royal Society of London, for the Improving of Natural Knowledge," by Thomas Spratt, late Lord Bishop of Rochester.

which Sharpey gave him had passed away, he did very little more during the course of a long life. It seems all the more necessary to commemorate Sharpey on this occasion because he has left comparatively few writings behind him, and any one who should judge by them alone of his influence upon physiological progress in this country would grievously underestimate it. For Sharpey was above all a teacher, and his work was written not with pen and ink on paper or parchment, but was engraved upon the hearts and minds of his pupils and friends. Upon two of these, especially, has Sharpey's mantle fallen, and to Burdon Sanderson and Michael Foster we owe a revival of experimental physiology in this country, a revival of the method which Harvey not only used in making his great discovery, but also employed to demonstrate the truth of it to the rulers of this land. By their writings, by their lectures, by their original experiments, by their demonstrations, and by the pupils they have trained, Burdon Sanderson and Michael Foster, under the auspices of Acland and Humphrey, have diffused among the medical men of this country a knowledge of physiology so extensive and exact as could only be found, before their time, among those who had made a special study of the subject. Yet more than to them, more than to any one else since the time of Harvey, do we owe our present knowledge of the circulation to Carl Ludwig. He it is who first enabled the pressure of blood in the arteries to record its own variations automatically, so that alterations could be noticed and measured which were too rapid or too slight to be detected by the eye. To him, also we owe the plan of artificial circulation by which the changes in the functions of the organs and in the vessels which supply them can be observed, quite apart from the heart, lungs, or from the nervous system.

Like Sharpey, Ludwig is a great teacher, and like the great architects of the middle ages, who built the wonderful cathedrals which all admire, and the builder of which no man knows, Ludwig has been content to sink his own name in his anxiety for the progress of his work, and in his desire to aid his pupils. The researches which have appeared under these pupils' names have been in many instances, perhaps in most, not only suggested by Ludwig, but carried out experimentally with his own hands, and the paper which recorded the results finally written by himself. In the papers which have appeared under his pupils' names we find their obligations to the master recorded in such terms as "unter Mitwirkung." But no one, except those who have worked with him, can understand what such co-operation meant.

The graphic method introduced by Ludwig for the purpose of measuring the blood pressure was adapted by Volkmann to the registration of the pulse in man, and the same method has been modified and rendered more easily applicable at the bedside by Marey and Chauveau, to whom we chiefly owe our knowledge of the modifications in the form of the apex beat and of the pulse curve. It is to Ludwig and his scholars, however, that we owe the greater part of our knowledge of the mechanism of the circulation, and of the varying distribution the blood in various parts of the body.

The effect of emotion upon the heart was carefully noted by Harvey, who says: "For every affection of the mind which is attended with pain or pleasure, hope or fear, is the cause of an agitation whose influence extends to the heart."*

Not only was Harvey well acquainted with the fact that the beats of the heart vary very much in strength and force, but he also knew that the circulation in various parts of the body may be very different at one and the same time. He says: "It is manifest that the blood in its course does not everywhere pass with the same celerity, neither with the same force in all places and at all times, but that it varies greatly according to age, sex, temperament, habit of body, and other contingent circumstances, external as well as internal, natural or non-natural. For it does not course through intricate and obstructed passages with the same readiness that it does through straight, unimpeded and pervious channels. Neither does it run through close, hard, and crowded parts with the same velocity as through spongy, soft, and permeable tissues. Neither does it flow and penetrate with such swiftness when the impulse (of the heart) is slow and weak as when this is forcible and frequent, in which case the blood is driven onward with vigor and in large quantity."

"And what, indeed, is more deserving of attention than the fact that in almost every affection, appetite, hope, or fear, our body suffers, the countenance changes, and the blood appears to course hither and thither. In anger the eyes are fiery and the pupils contracted; in modesty the cheeks are suffused with blushes; in fear, and under a sense of infamy and of shame, the face is pale, but the ears burn as if for the evil they heard or were to hear; in lust, how quickly is the member distended with blood and erected."†

Harvey's great contemporary, Milton, though so violently opposed to him in politics, would certainly not remain in ignorance of Harvey's work, and he has noted the changes in the color of the face produced by emotions. In describing the behavior of Satan on his journey from Hell to Paradise, he says:

"Thus while he spake, each passion dimm'd his face,
Thrice changed with pale—ire, envy, and despair;
Which marr'd his borrow'd visage."‡

But although these facts were known to Harvey so long ago, it is only in comparatively recent years that the mechanism by which they are brought about has been investigated, and it is only within the last decade that physiologists have begun regularly to believe that the cardiac muscle has a power of rhythmic pulsation independent of its nerves, although Harvey had noted that when the heart was cut into small pieces the fragments would still continue to pulsate. We may fairly, indeed, compare the movements of the heart, as regarded by physiologists of the present day, to those of a horse which is capable of going independently, although its pace may be slowed or accelerated by the reins or spur of the driver. The power of the vagus to act as a rein to the heart, and slow its movements, or stop them altogether, was first noted by Edward and Ernest Heinrich Weber, while the effect that it sometimes has of accelerating instead of slowing, like the effect of shaking the reins of the horse, was observed by Schiff, Moleschott, and Lister.

The accelerating nerves of the heart and the position of the nerve center from which they spring, were more thoroughly investigated by Von Bezold,* while the power of the vagus to weaken as well as slow the heart was observed by Gaskell. The position of the cardiac center, which, like the rider, regulates the movements of the heart, was located in the medulla oblongata chiefly by Ludwig and his scholars. Like the heart, the vessels also are regulated in diameter by the nervous system in accordance with the wants of the body generally; and the effect upon the vaso-motor nerves, which, when cut, allow them to dilate, and when stimulated cause them to contract, was discovered by Bernard, Brown-Sequard, and by our countryman, Waller; while the power of other nerves to cause immediate dilatation was discovered by Bernard, Eckhardt, and Ludwig in the submaxillary glands, penis, and peripheral vessels respectively.

The heart, when cut out of the body, still continues to beat, and the transmission of excitation from one cavity to another was experimented on by Paget, although removed completely from the influence of the central nervous system, and the vessels have a somewhat similar power of independent contractility. The alterations produced in the circulation generally and locally by the contractile power of the vessels, and the changes caused in the vessels by the central nervous system, by peripheral stimulation of the nerves, or by variations in the quality of the blood, have formed the subject of a series of researches extending over many years; and though originated and in many cases entirely conducted by Ludwig, have appeared to a great extent under the names of his pupils. The starting point of these investigations was an examination of the changes of the blood as it flowed through isolated organs, with the view of ascertaining in what manner the combustion by which the animal heat is maintained was effected in the body. While keeping up the circulation of blood through the vessels of muscles severed from the body, Ludwig and Sezelkow† observed variations in the flow which appeared to indicate contractile power in the vessels themselves. This research was carried on under Ludwig's direction by various of his scholars in succession, Alexander Schmidt, Dogiel, Sadler, myself, Hafiz, Lepine, A. Mosso, Von Frey, and Gaskell. Their observations, as well as those of Cohnheim and Gunning, have shown that the muscular fibers of the arterioles, not only in the muscles but throughout the body generally, have a power of independent and sometimes rhythmical contraction and relaxation. Their contractility is, however, controlled by the central nervous system in accordance with the wants of the body generally. For the amount of blood contained in the body is insufficient to fill the whole of the vascular system at once; and when the vessels are fully dilated, as they are after death, we find that nearly the whole of the blood of the body may be contained in the veins alone. It is, therefore, necessary that when one part of the body is receiving a larger supply of blood, another should be receiving a smaller supply; and the functions of the vaso-motor centers have been well compared by Ludwig to the turncocks in a great city, who cut off the water supply from one district at the same time they turn it on to another. Thus it is that when the brain is active the feet may get cold, and Mosso has shown this in an exceedingly neat manner by placing a man on a large board delicately balanced at its center, and demonstrating that whenever the man began to think, the increased supply of blood to his brain caused the head to go down and the heels to rise up. A similar condition was indicated by Mayow, who gave a different explanation. He said that the vital spirits were not able to be in the same place at once, and therefore it happens that if a man eats a heavy meal, he is apt to become drowsy, because the vital spirits descend from the brain to the stomach in order to carry on digestion; and, on the other hand, if a man thinks vigorously after dinner, the vital spirits have to leave the stomach to go to the brain, and consequently digestion is imperfectly performed. If we substitute the word blood for vital spirits, we have an exact expression of present physiological ideas.

Ubi stimulus ibi affluxus was an old doctrine and expressed a great truth. Wherever the need for increased nourishment or increased supply of oxygen exists in the healthy body, thither does the blood flow in larger quantities than usual. If the glands are active, their blood supply is greatly increased, as was shown by Bernard, and a similar occurrence takes place in the contracting muscle, as has been shown by Ludwig and his scholars. The vessels of the intestines and of the skin, with their numerous glands, have their caliber regulated by the vaso-motor nerves which proceed from the center in the medulla oblongata. This center acts most readily upon the vessels of the intestine, and rather less readily on those of the skin. In consequence of this, when the center is irritated, the vessels of the intestine contract and drive the blood through the skin, so that it is warmer than before, and it is only when the stimulation is very great that the vessels of both contract so that the skin receives less blood than normal, and becomes colder than before. But if the vessels of the skin and intestine are both contracted, where does the blood go? This question was put by Ludwig, and answered by the experiments which he made with Hafiz. It is evident that if the heart be stopped while the blood pressure is being measured in the artery of an animal, the pressure will fall regularly and steadily, because the blood is flowing out all the time through the arterioles and capillaries into the veins. One would naturally expect that if the arterioles were contracted by irritation of the vaso-motor centers in the medulla, the fall of blood pressure would either not take place at all, or would be very much slower than before; but on trying the experiment, Ludwig and Hafiz found, to their surprise, that the blood pressure fell almost as quickly as when the vaso-motor center was left alone and the vessels of the skin and intestine therefore remained uncontracted. In other words, the vessels which supply the muscles of the body and limbs are capable of such extension that when fully dilated they will allow the arterial blood to pour through them alone nearly as quickly as it usually does through the vessels of the skin, intestine, and muscles together. This observation, it seems to me, is one of the greatest importance, and one that has hardly received as yet the attention which it merits.

It is obvious that contraction of the cutaneous vessels, such as occurs upon exposure to cold, will drive more blood through the muscles, and as oxidation goes on more rapidly in them, the result will be increased production of heat.

The experiments I have just mentioned show that the vessels of the muscles are not controlled by the vaso-motor center in the medulla oblongata in the same way as those of the intestine and skin. How far their vascular centers may be associated with those for voluntary movements, which has been so admirably localized by Ferrier in the cerebral cortex, still remains to be made out. The circulation through the muscles is indeed a complex phenomenon, and it was shown by Ludwig and Sadler to depend upon at least two factors having an antagonistic action. When a muscle is thrown into action, it mechanically compresses the blood vessels within it, and thus tends to lessen the circulation through it, but at the same time the stimulus which is sent down through the motor nerve, and which calls it into action, brings about a dilatation of the vascular walls, and thus increases the circulation through the muscle.

When the amount of blood is measured before, during and after stimulation of its motor nerves, it is sometimes found that the flow is diminished, at others that it is increased, the alteration depending upon the comparative effect of the mechanical compression of the vessels of the muscles just mentioned, and upon the increase of their lumen by the dilatation of their walls. It invariably happens, however, that after the muscle has ceased to act, the flow of blood through the muscle is increased. This increase is quite independent of any alteration in the general pressure of blood in the arteries, and it occurs when an artificial stream of blood, under constant pressure, is sent through the muscle. The dilatation in the muscular vessels, as indicated by the increased flow of blood, and consequent change of color in the frog's tongue, was observed by Lepine after stimulation of the peripheral ends of the hypoglossal and glosso pharyngeal nerves, and the actual changes in the vessels themselves were observed microscopically by Von Frey and Gaskell.

The dilatation of muscular vessels on irritation of peripheral nerves was thus brought into a line with the dilatation noticed in the vessels of the submaxillary gland by Bernard, and in the corpora cavernosa by Eckhart. It is evident that alteration in the size of such a huge vascular tract as the muscular arteries must influence, to a great extent, the blood pressure in the arteries generally, and it is equally evident that the changes induced in the condition of the blood pressure by muscular action may be of two kinds, either a rise or a fall. If the arterioles are compressed by the muscles so that the flow through them is impeded, the general blood pressure will rise. When this effect is more than counteracted by the dilatation of the arterioles themselves under nervous influence the general blood pressure will fall, for the blood will find an easy passage through the vessels from the arteries into the veins. We can thus see how readily a rise or fall in the general blood pressure may be induced by exercise of the muscles. If they contract suddenly or violently they will tend to compress the arterioles and raise the blood pressure, while quite easy contraction will have little effect in compressing the arterioles, and these, becoming dilated, will allow the blood pressure to fall.

But there is still another factor which may tend to increase the blood pressure during severe muscular exertion, viz., a quickened pulse for stimulation of the nerve fibers extending from the muscles to the central nervous system greatly accelerates the beats of the heart. In this respect stimulation of the muscular nerves differs from that of the cutaneous and visceral nerves, inasmuch as the latter tend rather to slow than to quicken the pulse. The peculiar effect of the muscular nerves upon the heart would, indeed, appear to be a provision of nature for the purpose of maintaining an exceedingly active circulation during the active calls upon nutrition which violent exertions entail. Muscular exercise, therefore, has a special tendency to raise the blood pressure in the arterial system, and consequently to increase the resistance which the left ventricle has to overcome. Moreover, in the case of the intestinal vessels there is a special provision made for preventing their contraction from causing too great a rise of arterial pressure. This consists in the depressor nerve, which passes from the heart and tends to produce dilatation of the abdominal vessels, and thus prevent any undue pressure occurring within the heart from their excessive contraction.

In the case of the muscles, we have no such nerves. Its place seems to be taken by the dilating fibers which occur in the motor nerves. As I have already said, however, this effect of dilatation in the muscular vessels may be at first more than counteracted by mechanical compression at the commencement of exertion, and thus the blood pressure in the arteries, and the resistance which it opposes to the contraction and emptying of the ventricle, may be unduly increased.

(To be continued.)

* "The Works of William Harvey," Sydenham Society's edition, p. 70.
† Ibid., p. 128-129.
‡ "Paradise Lost," by John Milton, Book iv., p. 85.

* Von Bezold, "Untersuchungen uber die Innervation des Herzens," 1863. Leipzig: Engelmann.
† Ludwig and Sezelkow, "Henle and Pfeuffers Zeitschrift," 1863, vol. 17, p. 106 and vide p. 122.

SMALLPOX AND VACCINATION.

DR. R. BEVERIDGE has issued a succinct analysis of the epidemic of smallpox at Leith in 1893-94. From November 10, 1893, to August 20, 1894, there had been 405 patients admitted to hospital; 22 of these were not cases of smallpox. Of the 383 smallpox cases, 217 were males and 166 females; 69, or 18 per cent., were under fifteen years of age, and 314, or 82 per cent., were above that age. There were 50 deaths, giving a fatality of 13 per cent., which, Dr. Beveridge remarks, is above the average fatality in smallpox and indicates a severe type of the epidemic. The mortality among the male sex was higher than that among the females, the ratio for the former being 15 per cent. and for the latter 10 per cent. There were 7 deaths among those below fifteen years of age—i. e., 14 per cent. of the whole

number—while 43 of the fatal cases, or 86 per cent. of the whole number, were above that age.

As regards vaccination, 332 were vaccinated, 25 of whom died, giving a mortality of 7·5 per cent.; 20 were unvaccinated, of whom 10, or 50 per cent., died; and 31 were returned as doubtful; i. e., were stated to have been vaccinated, but bore no marks. Of these, 15, or 48·3 per cent., died. Analyzing these according to age, it is shown that among the 54 vaccinated subjects below fifteen years of age, there were no deaths, the 25 fatalities occurring among the 278 above fifteen years. Of the unvaccinated, 13 were below fifteen years of age, and 7 of them died; 7 were above fifteen years, and 3 of them died. Of the doubtful group, all but 2 were over fifteen years of age, and among these occurred the 15 deaths. It is further shown that the mortality rose in each decennial period beyond the age of fifteen years. An instructive table is given in which the degree of vaccination in relation to mortality is brought out. Thus, among those (all being above fifteen years of age, since no vaccinated subject below that age died) who bore "one good vaccination mark," there were 75 cases and 6 deaths, or 8 per cent.; among 28 with "one indifferent mark," there were 8 deaths, or 28·5 per cent.; among 134 with "two good marks," there were 8 deaths, or 5·9 per cent.; among 28 with "two indifferent marks," there were 2 deaths, or 7 per cent.; among 9 with "three (and 1 with four) good marks," there were no deaths; and among 4 with "three indifferent marks," there was 1 death, or 25 per cent. "There was no case in the revaccination class. In this connection it may be mentioned that there were several patients suffering from concurrent vaccination and smallpox, but the course of their illness showed that they must have received the infection of smallpox previous to the time that they were vaccinated. In no case did a person who had been successfully revaccinated and had recovered therefrom suffer from smallpox." Dr. Beveridge further points out that 9 infants admitted with their mothers (who were suffering from smallpox) did not contract the disease; of these infants, 4 were successfully vaccinated, for the first time in hospital, and 5 had been vaccinated when younger. This testimony to the efficacy of vaccination is further strengthened by the statement that "during the epidemic there was a total of about fifty servants (nurses, etc.) in connection with the hospitals; none had suffered from smallpox previously; all had been successfully revaccinated, and none of them developed smallpox."—Lancet.

THE FORESTS OF WASHINGTON TERRITORY.

WHEN the traveler is passing through the far-off regions of the Dominion of Canada to Vancouver and then, in the United States, through the territories of Washington and Oregon, he has occasion to admire the grand trees of imposing aspect that he observes in the forests. Unfortunately, the inhabitants of the two countries see in all these marvels of nature only the money that they can draw from them as quickly as possible, and so the exploiting of them is carried on without stint. New sawmills are springing up everywhere, and the commercial movement produced by the exploitation of the forests is daily assuming extraordinary proportions. The waste is likewise extreme, for the Americans are burning splendid trees around their nascent cities, or are ruthlessly cutting them down. They often leave them to rot upon the ground for want of practicable roads upon which to carry them to the sawmills. Light and space are necessary, so everything is destroyed as far as to a distance of several miles.

In the interior of the forests, the government is selling large lots that are cleared and put under cultivation, or else are exploited for timber to be used for building purposes. It is complete destruction. The government of the United States, although very tardily forewarned, is beginning to perceive the bad effects of this tree cutting beyond measure. While there is still time for it, it has appointed special commissions charged with the selection, in the finest portions of the virgin forests that remain, of reservations designed to protect the springs and watercourses.

Thus, in Washington Territory, some areas of forest land will be respected for ever near the cities of Seattle and Tacoma. Thirty years ago, Seattle was composed solely of a few cabins constructed in the very forest and inhabited by wood cutters. Twenty-five years ago it had become almost a city, and in 1885 it had a population of 22,000. The clearing away of the forest is gradually going on, and the city is increasing to an incredible degree. At the last census, in 1893, it contained 43,000 inhabitants. In the vicinity of Seattle, a reservation has been set apart under the name of Ravenna Park. The traveler may there admire a few gigantic trees and a pretty mineral spring which daily attracts numerous visitors.

I was especially desirous of visiting the great exploited forests of the Territory that are situated far from the cities. I was told that it was the territories of Snoqualmie that would offer the finest glimpses. The forest there is in fact admirable. The wood most in demand in Washington Territory is what is called fir. There are three species of this—the red, the yellow and the white. The red is found especially along the coast of Puget Sound. After it has reached a height of 600 feet it no longer does well. It grows straight and rapidly, and so the pieces of timber that are cut from it are selected especially for the construction of bridges. The yellow fir grows to higher altitudes than the preceding, and may be observed upon the picturesque summits of the mountains and along the edge of the torrents. The trees of this species are counted among the largest. Many of them reach a height of 250 and 280 feet, but the wood of the yellow fir is softer than that of the red and the white, yet nevertheless resists the vicissitudes of the climate. It is employed for the flooring and wainscoting of houses. The wood of the white fir is of a more inferior quality. This tree is less abundant in the forests and does not reach an extraordinary development.

The Washington spruce or pine also is quite abundant. It is no less imposing than the others in height and in diameter at the base, and its qualites approach those of the white fir or white spruce. Finally, the hemlock or Alaska pine (Tsuga Mertensiana) completes the series of the trees abundant in these forests. There are two varieties of it, the white and the red, the bark of which is very rich in tannin. I was led to a section that has been exploited for some years by a Mr. Guilfoil. It is situated in the depths of the forests, but access to it is easy through a long road of over three miles that the lumbermen have cut through the mountain for the exploitation of the magnificent trees found there. At the moment of my arrival with my guide the lumbermen were felling a spruce 230 feet in height and nearly six feet in diameter. It took no more than three-quarters of an hour for this operation.

FIG. 1.—TRUNK OF A TREE PREVIOUS TO BEING SAWED INTO SECTIONS.

FIG. 2.—CROSSING AN ARM OF A LAKE IN THE FOREST OF SNOQUALMIE BY STEPPING FROM ONE LOG TO ANOTHER.

FIG. 3.—PRIMARY SCHOOL OF ELBY, IN THE FOREST OF TACOMA.

Two men began to saw through a third of the thickness of the tree at a height of five feet above ground, with a long saw analogous in form to those that our workmen employ for cutting dressed stone. This business finished, the men attacked the opposite side of the tree (the one toward which it was to fall) with axes and made a deep incision in it. The giant of the forest then lost its equilibrium and fell with a crash in the midst of the other trees. The magnificent branches were cut off and placed in piles around its immense cadaver. The bark, which was removed by degrees, was taken away to be burned and the workmen then sawed the trunk into sections of about thirty feet. Fig. 1 gives a reproduction of a photograph showing one of the felled trunks, upon which thirty-five of the gang of laborers found it possible to stand.

After a large trunk has been divided into sections, a long wire mounted upon a roller is unwound by means of a 15 horse power steam engine fixed upon a revolving disk. The extremity of this wire is provided with an iron hook, which is affixed to the tree, and the latter is then gradually hauled in the desired direction and placed upon the roadway. Ten horses or oxen are harnessed to and drag the section to a place in the forest where the mountain presents a very steep slope descending to a small lake. The trunk placed upon this slope, which is rudely leveled by long branches of spruce, slides down with great speed, and is soon floating alongside of other pieces that have preceded it. They are easily pushed along the surface with rowboats, although these huge sections are capable of supporting several men. The lumbermen jump from one log to another to effect the necessary maneuvers, and the pieces are soon moved to the spot where they are to be placed upon the railway platforms. My guide persuaded me to try to cross a small arm of the lake as he did, by jumping over the cut trees. I did so, but not without experiencing a certain apprehension (Fig. 2).

Tacoma, like Seattle, a new city, is also admirably situated on the interior sea formed by the Pacific. A reservation has likewise been selected at a place called Point Defiance, at the edge of the ocean. Tacoma possesses another attraction, and that is a magnificent view of Mount Rainier, which rises to an altitude of 15,000 feet, and forms one of the most beautiful panoramas that can be seen in the world. This mountain, an ancient extinct volcano, is still surrounded with thick forests. The trees are beginning to be exploited, but it has been decided to save an important portion of them located in a valley near a small station called Long Mires. It is a place known by its springs of chalybeate gaseous water. Natural hot baths also are taken here. The new reservation is called Paradise Valley. To get there, at present, the trip is not very easy. The railway is taken as far as to Lake Spanaway and then a carriage takes one, in four hours, through a partially cleared forest, and over a primitive road, as far as Eatonville, where one finds an inn in which to pass the night. Here the forest is dark and mysterious. It still dominates the whole country and is resplendent in all its beauty. There is a long stretch before reaching Long Mires at the foot of Mount Rainier. It is necessary to ride nine hours on horseback over indescribable roads and in the thickest of the forest. In the wonderful places that are thus traversed one does not regret the fatigue experienced. The ride taken with my young guide under leafy domes 200 feet in height, and among ferns and spruces (the latter often more than 6 feet in diameter), can never be forgotten. Along the road one passes from time to time through openings. These are parts of the forest that have been cleared by intrepid pioneers, who have established cultivated fields for their sustenance. Here they have laboriously felled the immense trees and constructed their cabins. These first colonists, despite the remote places and deserts in which they are located, are not so isolated from civilization as one might think. The government of the United States has not been unmindful of the children of these brave people and has established some schools in the forest, whither they can go to learn the first indispensable rudiments. A master is in attendance every day in a modest wooden house to give lessons to the children of both sexes of the pioneers and farmers of the vicinity. Familiar with the forest, they reach the rendezvous in safety to which they are sent by their parents. Fig. 3 shows the little school of Eloy. In this small board house we found a dozen children, all of whom were attentive and studious; but at the hour of recess nothing was more charming than to see them jumping and running with glee among the huge felled trees that surrounded the school house. Such a play ground is not commonplace, at least.

I continued my journey in order to finally reach Long Mires, the point of my destination.

At the time at which I was there, in the beginning of July, 1893, Paradise Valley was covered with snow. I ascended to it, however. There were none of the beautiful flowers that were met with a little later on, but I was enabled to admire the elevated forests of spruces and the immense glaciers of Mount Rainier. After comfortable hotels shall have been established in these places, and practicable roads shall have been made through the forest in order to render it possible to reach them, Paradise Valley will become as celebrated as that of the Yosemite of California.—A. Tissandier, in La Nature.

PHYSALIS FRANCHETI, MAST., SP. NOV.*

THIS is a relatively gigantic species of Bladder Cherry, the seeds of which were brought from Japan by Mr. James H. Veitch. As will be seen by the engraving, this is very closely allied to the European P. Alkekengi, so closely, indeed, that M. Franchet in the Enumeratio Plantarum in Japonia sponte crescentium, vol. ii. (1879), p. 454, describes it as a variety of P. Alkekengi, but without attaching any name to it. Botanically, there can be no question that it is an offshoot from P. Alkekengi; nevertheless, for garden purposes it is abundantly distinct, and that being so, it will tend to avoid confusion by giving it a distinct name. It differs from P. Alkekengi in being an unbranched annual, not a perennial, with a fibrous root, with erect branches, not creeping at the base, glabrous instead of setose, in its much larger size, in the leaf stalks being considerably shorter in proportion to the blade than in P. Alkekengi—all points separately of minor importance, but which for garden purposes give it a distinct value. It is very striking in appearance, and the cherry-like fruit is edible, though some practice is wanted to make it palatable!

It was shown by Messrs. Veitch at the Royal Horticultural Society.

P. Alkekengi is a native of Central Europe, the Levant, Persia, Turkestan, China, Corea—a fact which of course strengthens the notion that the present plant is a direct offspring from Alkekengi.

PHYSALIS FRANCHETI—JAPANESE BLADDER CHERRY.

Alkekengi is said to be derived from the Arabic name for the plant.—M. T. M., in The Gardeners' Chronicle.

* Physalis Franchetii, Mast., sp. nov.—Annua, bipedalis et ultra robusta glabrescens, caulibus erectis, nec basi repentibus, crassitie pennæ cygneæ, ad nodos valde incrassatis, vix ramosis, prominenter angulatis; foliis amplis longe petiolatis, petiolis 4-5 cent. long, comparate brevioribus quam in P. Alkekengi, laminis amplis 10-13 cent. long, 7-8 cent. lat., ovatis abrupte acuminatis sinuatis basi sub rotundatis seu cuneatis; calycis tubo imprimis cylindrato, sepalis oblongis obtusis; corolla diametro fere pollicari, albo-flavescente late aperta rotata; antheris luteis; pedunculo fructifero 5 cent. long, glabro; calyce accrescente pallide rubro-aurantiaco, circa 6-7 cent. long, 6 cent. lat. et ultra valde inflato, 5 angulato, angulis subalatis nervis intermediis minoribus, ovato vel suborbiculari basi intruso; fructu globoso magnitudine cerasi, aurantiaco.

Vidi specimina exsiccata a cl. Bisset et a Maximowicz lecta nec non plantas in hort. Veitch cultas e seminibus a Japonia a cl. J. H. Veitch allatis.

THE LITHOGRAPHIC STONE QUARRIES OF BAVARIA, GERMANY.

By A. R. CROOK

ABOUT midway between Munich and Nurnberg, Bavaria, on the Altmuehl, a tributary of the Danube, are some of the most valuable and interesting quarries of the world. They are the quarries of Solenhofen, Moernsheim, Eichstaett, and Kelheim, famous for an unusually fine variety of limestone, which is known as lithographic stone.

Though the Solenhofen quarries were worked by the Romans, and though there are at present upward of three thousand men employed in them, they show no signs of exhaustion.

In early times the thicker stones obtained were used for building purposes and the thinner ones for tiling of roofs and floors, for table tops, etc., and to-day, through all that region, there is hardly a house that is not built and tiled with these stones. But sixty years ago it was discovered they were more valuable for other purposes than in building. One Senefelder, a poor German playwright, one day, not finding any paper at hand, wrote on a polished piece of the stone from Kelheim, which he had purchased for grinding his ink, a wash list for his mother. Returning next day and seeing the writing, it occurred to him to try the effect of acid on the stone, as he had been seeking to find a cheap method for copying his plays. In five minutes the acid had eaten away one one-hundred-and-twentieth of an inch of stone, where it was uncovered by the greasy ink, and Senefelder found that he could print copies that were quite legible though not very delicate. After several years' work he succeeded in perfecting this process, was pensioned by the King of Bavaria and lived to see the art of lithography perfected.

After this discovery these quarries increased enormously in value, for they contain by far the best lithographic stone in the world. And this is one of the reasons why the Germans do the finest lithographic work that is done by any artists in the world.

True, some lithographic stone is found in England, France and Silesia, and some from the cretaceous formation on the celebrated Mount Parnassus in Greece, and the Upper Carooniferous of the Volga River, the Carboniferous of Missouri and Illinois, the Subcarboniferous (barren limestone) of Kentucky; the Lower Silurian (Bird's Eye) of Canada contains some deposits; and beds have been reported in Virginia, Indiana, Arkansas and Texas. But these are all of a quality much inferior to the Bavarian stone; and the American occurrences are so poor that none are worked for lithographic purposes, consequently the United States imports the quantity it uses to the amount of $100,000 yearly.

With all the miles of territory, all the geological strata and different varieties of rock that the United States possesses, it is more than probable that she has good lithographic stone. The reason that it has not been discovered is to be found in the fact that it has not been searched for by men who understand the characteristics and qualities desirable. The discovery of such quarries would well repay the effort. The Bavarian lithographic stone occurs in the upper division of the "White Jura" or "Malm," as the formation is called in Germany, or "Upper Oolite," as it is called in England and France. The formation is peculiar in that it was deposited in troughs, so that it lies not above but lower than the sides of the "Franconian dolomite," which preceded it in order of deposition.

The mass consists of almost pure carbonate of calcium, slightly mixed with silicious clay, dolomite, and bitumen. It is remarkably homogeneous and fine grained, generally of a gray or light cream color, and can be split into plates several feet square and of a uniform thickness, which varies from seven inches to one-

twelfth of an inch. This capability of being divided into large sheets as thin as pasteboard is a quality rare in any stone except slate, and hence these stones are often called lithographic slate, although they are limestones.

After examining the quarries at Solenhofen and Moernsheim I went to Eichstaett, to the quarry of Mr. Ehrensberger, where I found stone occurring in layers of from three-eighths to three-quarters of an inch in thickness, and of remarkably uniformly fine grain, superior even to that of Solenhofen and Moernsheim for lithographic plates and multiplying apparatus. So excellent are these stones, and so easy to quarry and so light to transport, that it is not surprising that they supply the markets of the world, and that the United States imports them in such great quantities.

The quarrying is very simple, for no blasting is necessary. The layers are so loose that they can be removed with shovel and pick. Little machinery is needed to handle them, as plates of large dimensions are not wanted. The stones are trimmed with small hammers and chisels and polished with sand and water. The harder layers, used for the finest work, are afterward polished with pumice, and for chalk drawing and graduated tints are given an artificial grain with ground glass.

At Mr. Ehrensberger's quarry at Eichstaett, below the surface soil, are (a) six feet of silicious limestone; beneath which lie (b) ten feet of thin-layered argillaceous limestone, followed by (c) thirty-two feet of the hardest layers called "Flinzschichten." There are about thirty-eight of these latter layers, which are composed of about four hundred plates. Of these plates thirty-four are suitable for lithographic purposes. The whole series are laid out as level as a floor. Underlying them is a base of irregularly deposited limestone masses which rest on the Franconian dolomite. The roof of the shop has the characteristic tiling.

In another way than in its uses in the fine arts and printing is this famous stone financially important, and that is in its returns to the quarry owners for the sale of scientific material which it has inclosed within its layers.

The fossils that it contains have been sold for thousands of dollars. For one specimen (Archæapteryx) the British Museum paid $3,500, and the Berlin Museum for another of the same kind $5,000, and thousands of less high priced specimens have been sold.

But this financial interest is nothing compared to the great scientific importance of the store of extinct animals that have been preserved through so many ages, and now give a vivid picture of the animal and (meager) plant life of that country at that time. The conditions of preservation in this region were unusual. "When we," says Prof. Zittel, one of the most famous of European paleontologists, "recognize in the lithographic stone distinct impressions of Medusæ (jelly fish), whose bodies consist merely of soft jelly, and as a rule disappear like a breath when the animals die; when numerous Libellulæ (dragon flies) and other insects have impressed thereon even the finest lineaments of their delicate wings; when long-tailed crabs are found in the stone with complete feelers and legs; when naked cuttlefish have left distinct contours of their bodies, then we must certainly agree that there must have existed conditions of preservation such as we can scarcely expect to find in another place."

And because of these fine conditions of preservation the remains of more varieties of animals than are contained in the best zoological garden in the world have been here preserved. More than 500 different species have been found in such perfect condition that they can be thoroughly studied and understood. Had it not been for the remarkably quiet condition of these inland seas and the slow deposition of the unusually fine homogeneous sediment which they contained, the delicate parts of many animals and many fragile species would have been destroyed, and thus important facts which aid in establishing brilliant and helpful theories would be wanting.

Among these fossils one of the most famous and interesting is Archæapteryx, an animal which supplies one of the much demanded and long sought "missing links," for it has the general appearance and structure of a bird and a covering of feathers which are strikingly preserved on the wings and tail. But it has the teeth of a reptile, and its tail consists of twenty vertebræ, as does the tail of no bird. There are two feathers to each vertebra. Of the two Archæapteryx that have been found, one is in London and the other in Berlin, as mentioned before. They are pictured in most geologies.

Hardly less interesting, but of much more common occurrence, are different species of the Pterosauria (flying lizards). Some excellent specimens of them have lately been found.

The Pterodactylus, i. e., wing-fingered, was a peculiar flying reptile, which varied in size from that of a sparrow to that of an eagle. It also was one of the missing links, representing as it did animals that had teeth and other parts of skeleton like those of a reptile; head, general form and pneumatic bones of a bird; naked or furry body and wings like those of a bat, which is a mammal. This specimen is well preserved. The head, thrown back in a position usual in these fossils, shows the teeth quite plainly; the shape of the jaw bones, the large eye cavity, and all parts of the body, except the wing, are seen.

The "bill-muzzle" greatly resembles the "wing-fingered," but differs in having a long tail and a rounder beak. The wings of the two, however, are alike, consisting not of feathers, but of a thin narrow membrane, supported by the greatly prolonged little finger, which is four jointed and twenty-five times as long as the other fingers. The finest Pterodactylus ever found was the first one found. It was taken from the Eichstaett quarry in 1784. Since then a number of beautifully distinct examples have been obtained, and the greater number of them are now in the museum at Munich.

A Homeosaurus shows all that remains of an animal that was once very like a lizard, and whose nearest descendants to-day are the sphenodous, which live in New Zealand. Ribs, vertebræ, fins, and some of the head bones can be clearly distinguished.

But the most commonly occurring fossils are the fish, which are present in fine condition and large numbers.

There is a Spathobatis, one of the "Eagle Rays." The depressed body is a given triangular shape by the broad pectoral fins, which are closely joined at their base to the body. The ventral and caudal fins also are well shown in this example.

A fish very often found is Caturus, a species belonging to the same order as the dog fish, but resembling the salmon in form and size. Some examples found are more than three feet in length. In this specimen the head bones are distinct, and the scales and fins well preserved.

Another fish characteristic of this rock is Pholidophorus, one of the Lepidostean fishes, which have thick enamel scales shaped like rhombohedrons. Their arrangement in rows and the large dorsal fin are beautifully preserved in this specimen.

In the waters which formed these rocks crabs were present in large quantities and in many varieties. Among them are Aeger, the long-tailed crab with complete antennæ and legs; and Limulus, the horseshoe crab; Eryon; Penaeus, shrimps; Palinurina; Eryma, etc.

A partial list of the animals found in these strata would embrace, among those not already mentioned, dragon flies, ammonites, belemnites, star fish, jelly fish, earthworms, various shell fish, algæ, remarkable not more for their number than for the state of their preservation. A view of these fossils is enough to show how valuable are the gifts which these quarries have contributed both to art and science, and have added to the knowledge and happiness of mankind. —Stone.

ANTWERP: ITS HISTORY—THE CATHEDRAL AND FETE OF THE ASSUMPTION—THE STEEN—THE PLANTIN MUSEUM.

ANTWERP is too level and too low to be beautiful, but ever since the Scheldt, winding lazily through marshy meadows, began to carry trading vessels to the sea, it has had high commercial importance and has not lacked citizens ready to risk fortune and life in its defense. The legendary origin of its name is perpetuated in the new fountain in the Grande Place. The story is that the giant who was ruler over the ancient burg exacted tribute of every vessel entering the river; if a shipmaster refused to pay it, the giant cut off one of his hands and threw it into the sea, and from the two words, hand and werfen, to throw, the word Antwerpen or Antwerp, by cutting and changing, has been made. The less dramatic supposition of the origin of the name is that it is derived from two words meaning on a wharf. Whichever origin is the real one, the name is a clew to the chief reason of the city's importance.

Antwerp has known almost every possible phase of disaster and prosperity. Founded in the seventh century, by the sixteenth thousands of vessels anchored in her harbor; the population numbered 125,000, and in wealth and influence she was the rival of Venice. Then swiftly came the blight of the Inquisition, and many of the best citizens fled to England. Later, when the Spanish yoke was at last thrown off, the city suffered from the jealousy of her Dutch neighbors, who wanted her trade for their own ports, and by the close of the eighteenth century her popoulation had dropped to 40,000. Under the French occupation at the beginning of the present century, the Dutch forts that had prevented ships from entering were dismantled, and once more trade revived. This, however, was not to last, for when the final struggle with Holland came, ending in 1832 with the independence of Belgium, the city suffered very severely. From that disaster she did not recover until 1863, when the season of prosperity which has increased ever since began. The shipping facilities are better now than at any previous time; the channel of the river along the wharves has been made of a uniform width of 1,150 feet and depth of 25. The wharves, stretching for more than two miles, are lined by low warehouses; the vessels are loaded and unloaded by means of noiseless hydraulic cranes, which carry goods directly to and from railway tracks. The fine ocean steamers of the Red Star and North German Lloyd lines, and the steamboats to Harwich, London, Glasgow, Newcastle, Leith, Liverpool, Dublin, Belfast and Rotterdam, mingle with the fleet of merchantmen in the harbor. In 1892, 4,404 ships entered the port.

Antwerp's strategic position is such that it has been made the strongest fortress in the little kingdom, and, indeed, one of the strongest in Europe. The massive walls and ramparts, eight miles in circumference, are planned with reference to concentrating behind them the whole Belgian army should the nation be threatened, and it is believed that 250,000 men would have to be gathered to the attack before the city could be taken. Looking at the museum pictures of the "Spanish Fury" and the later scenes of carnage, fire and desolation which have come to these now busy, peaceful streets, one can but hope that the years of darkness and anguish are all in the past.

These last three decades of prosperity and growth have seen the destruction of many of the old buildings along with the old walls, and except in a comparatively small section the city has now a modern aspect. In the new quarters the streets and boulevards are broad, have avenues of trees through the middle and are diversified by little gardens containing fountains and statuary; the buildings lining them are plain and substantial. A few of the finest private residences have grounds, but they are more or less hidden by walls, and on the whole the city gives the impression of being very compact.

Whereas in the cities of Germany, France and Switzerland the homes of rich and poor alike are in apartment houses, here they are unknown; each family in any but the poorest circumstances occupies an entire house, and there is variety enough in size to meet all demands. They are uniformly built close to the sidewalk, and the door is only two or three steps above it. In these new quarters, the most distant from the river, are to be found the greater part of the residences of the better classes. But even here the streets are very dirty and neglected and share with the old and narrow ones odors which suggest defective drainage.

The business is still mainly confined to the old, historic part of the town, its center being the Place Verte, once a cemetery, but now a park. Here stands the bronze statue of Rubens, of all her famous sons the one most honored by Antwerp in his lifetime and since his death.

Crossing this square, let us enter the south transept of the cathedral on Wednesday, the 15th of August. It is the Feast of the Assumption of the Virgin, especially observed here, because St. Mary is the patron saint of the city, and this is the Cathedral of Notre Dame. It is 10 o'clock in the morning, and the cathedral is already well filled with worshipers, many of whom have brought bouquets to lay around the figure of the Virgin, standing on a high pavilion under a canopy, near the center of the nave. The rather battered-looking, painted face of wood or papier mache, or some similar material, is partly hidden by the jeweled crown and lace about it. The figure, which is ordinarily kept in one of the side chapels, has been dressed for the occasion in gorgeous apparel. The long, crimson, brocaded velvet gown is stiff with gold embroidery in the back; the front is a mass of silver trimming, bordered with ermine; at the waist is a large monogram, "M. R.," in diamonds. In her right hand she holds a bouquet of silver flowers, and in the left a doll, representing the infant Christ, dressed in a rich robe and wearing a crown. Against every pillar of the nave stands a large, rich banner, adorned with gold and pictures, belonging to the church or some of its societies. These, too, have been placed here in honor of the occasion. The priests, in richest vestments, have begun the mass. The worshipers, standing or kneeling on chairs, now almost fill the church and some of the side chapels. They are of every age and condition. A large printed notice on the wall by the doors states that special indulgence is granted by the Pope to those who prove their fidelity to the Virgin and the church on this day; and through three successive masses, each one an hour in length, the church was filled with a congregation which changed, for the most part, as each new service began. It is, even to a Protestant, an impressive occasion. The faces are serious and devout; the great congregation stands or kneels by the signal from the altar bell. The voices of the priests are hardly audible in the middle of the nave, but the responses from the choir and the music from the sweet-toned organ and full orchestra are very solemn and beautiful.

The worshipers who have chairs are sure to be disturbed once by bustling, quaint little old women, in black caps and shoulder shawls, who slip about collecting a cent a chair; and a black-gowned verger comes around with a bag often enough to give every one an opportunity to contribute to the cathedral treasury.

The cathedral, a Gothic structure and the largest in the Netherlands, is beautiful; but with Cologne and Milan fresh in the memory, it does not seem grand. The flavor and interest given by age it possesses, for it was begun it 1352, and has had all kinds of vicissitudes—change of architects, delay, fire, pillage and restoration. It has six aisles and an ambulatory; the length of the nave is 128 yards; its width, 57 yards; height, 130 feet; the vaulted roof is supported by 125 fluted stone columns, which like the arches and the ceiling have a softened white tone. The pulpit, the stalls and two episcopal thrones and many of the confessionals are most beautiful examples of carved oak, dark and rich with age. The pulpit with medallions on the front, exquisite cherub forms about its canopy, and vines and birds upon its railing, is by Van der Voort, whose wood carving ranks with Verbruggen's; both are of a very high order. Some of statues on the confessionals by Verbruggen are marvels of delicate execution. The ten chapels of the ambulatory, as well as those in the north and south aisles, contain pictures of interest, chiefly by Flemish painters, but the most valuable ones hang in the transepts. They are the two famous paintings by Rubens, the Elevation and the Descent from the Cross. They are owned by the town, but were originally hung in the cathedral for want of other suitable place for them, and now, though they might be removed to the fine museum, they are still allowed to remain here. Both the pictures are triptychs, the one called the Descent from the Cross having that subject in the center, the Visitation on the left wing, and St. Simeon holding the infant Saviour on the right. Authorities say that the drawing is admirable; and certainly the scene is brought before one with a vividness that is painful. The Elevation of the Cross occupies the whole of the other triptych; the left wing having mounted officers and the thieves who are being nailed to their crosses; and the right containing a group of women and children with the Virgin and St. John, who are all looking, some with pain, some with horror, at the tragic scene in the center. Though this is not regarded as so fine a piece of work as the Descent, it is full of life and is startlingly real. Both of these pictures are kept covered except during high mass on Sunday. During the week, they are shown in the afternoon, for a franc.

But the Assumption of the Virgin, by Rubens, over the high altar is always in sight. Of the nearly 1,000 pictures which the artist painted, ten have this for their subject, and this one is considered among the best. It is a most pleasing picture: the Virgin is a lovely, ethereal figure among clouds and angels, and the group of apostles below gaze upward to her with wondering interest. The color is much more delicate than in many of Rubens' paintings, and the figures are without the obtrusive muscularity common in his work.

The exterior of the cathedral is seen to great disadvantage; in fact, there is no place where a good view of it can be obtained as a whole, for the reason that other buildings are crowded so close about it; but its airy, beautiful tower is the dominating feature in every view of the old part of the city. Like the church itself, it is built of pale cream-colored sandstone, of very friable quality, cut in rather small smooth blocks, which are laid in much mortar. It is 402 feet high, and was completed by Van Waghemakere in the sixteenth century. The lightness and grace of the structure one cannot but admire when seen from any point, but to realize in some degree what a problem the architect set for himself, and with what consummate skill it was worked out, you must climb to the gallery above the clock and study the work. Entering at the street, you follow a winding stone stairway in one of the outer four corner walls to the level of the lower edge of the great dial of the clock; here you emerge into a room which has only a shell of stone, and immense timbers help support the struc-

ture towering above. You cross this room diagonally and continue the ascent in another corner tower to the gallery above. Here you find a balustrade, about five feet high, surrounding an octagonal space, within which is the square central tower; this it is now not safe to climb.

The corner pillars of this central tower, even at this height, are very large; the window-like spaces which give the openwork effect to the whole structure are also large; they are formed of strong cut stone columns and are held together by iron clamps. The small projecting side columns which make the outer open work, adding strength and finish to the structure, are also bound to the more central parts by strong iron braces. Every detail of ornamentation is beautifully finished. The view from this gallery is fine; first, of the church itself, far below; its extent, the flying buttresses, the relation of the bulbous dome to the nave and transepts, the grouping of the chapels, can all be understood from here. One of the most interesting pictures from here is of the Grande Place, with the Hotel de Ville, the stepped houses in that square, the Steen and the river and meadows beyond, and that I am glad to be able to have reproduced from a photograph taken from this gallery. It is said that on a clear day, with a strong glass, the towers of Brussels and Ghent, thirty miles away, may be seen. On the way down, one of the custodians took us through a narrow doorway into the wide much-braced and many-timbered spaces of the tower where the forty bells are hung. The largest, weighing eight tons, is rung by sixteen men and only on fete days. "Santa Marie" and a companion bell, the next in size, are tolled only on the death of a distinguished personage. The chimes are grouped together near these two bells; they are of differing dimensions of course, and the smallest is only 15 inches in circumference. Our morning in the tower filled me with admiration for the genius equal to constructing an interior so intricate and wonderful and an exterior so elaborate and beautiful.

The Antwerp people love music and processions above everything else, and this week of the fetes is full of them. While the service which I have described was going on in the cathedral, a company of musicians took possession of the stand in the Place Verte, and the crowds who came from the service were ready to join the listeners gathering for the concert; in the afternoon, bands were parading the streets in different parts of the town; they had no great following, but the air was kept in motion. On Saturday evening, a beautiful procession went through the lower section of the town, especially along the broad street which has been opened near the wharves. The costumes of the sixteenth century, long bright cloaks and large hats, were very picturesque; there were allegorical floats and some representing scenes from Lohengrin and other well known operas. The last float, representing the triumph of light over darkness, is too great a conception to be realized in a satisfactory way; but it was followed by a company of white-robed, long-winged angels, who made a most beautiful concluding scene. The Antwerpians know that in order to have anything of this sort perfect, the streets must not be flooded with electric or any other light, but there must be just enough to give effects without revealing how they are produced.

On the Sunday after Assumption Day, the great religious procession of the year always takes place. Small altars are erected in two or three streets, and a high altar in the Place de Meir. This is a broad street, where there was once a canal; while it is in the old part of the city, near the Place Verte, it has handsome modern houses. As soon as the cathedral service at 10 o'clock was over, the procession started to make the circuit of these altars. I was one of the great company gathered to see it in the Place de Meir.

A white statue of the Virgin in a sitting posture had been placed upon the altar, and the wooden framework was covered with banners or other rich drapery; the steps were carpeted, and the pavement for some rods was strewn with leaves and flowers.

The quiet crowds are standing four or five deep on the sidewalk, and have formed a heavy line across the street. They are driven back by mounted police in no gentle manner just before the first notes of a march reach our ears. The military band is not far behind them; the moves in reverent step, playing solemn music. It is followed by companies of boys bareheaded; one division is in long violet gowns, another in red, another in blue; each carries a banner. Then follow priests, accompanied by a layman on each side carrying a long lighted candle. All the gorgeous cathe lral banners are interspersed among the groups of men who pass; they are carried by men dressed in long black gowns with short white ones over them.

A large guild composed of young men wearing long, full black silk gowns, and carrying lighted candles, passes in single file along the edge of the crowd; they are followed by others in dress suits, also carrying four-foot lighted candles, and some have rosaries in one hand. Older men in full dress file down—all have their heads uncovered—and all have a most reverential bearing; they are a fine-looking set of men, markedly superior to the priests who are passing in the center. Now a large silver casket containing the bones of 36 saints from St. Andrew's Church is borne along on men's shoulders and behind it, carried in the same way, comes the Virgin from the cathedral. Then follows a priest arrayed in a long rich robe, the trail carried by little boys; he holds the Host in a gold monstrant. A brief mass was said at the altar, and a benediction was pronounced upon all the people assembled. My position was such that I could not see this service, but I suppose the startling salute of guns that was fired announced the elevation of the Host.

The proc ssion returned to the cathedral in regular order; the laymen formed lines in the nave and choir through which the priests passed to their places at the high altar, another mass was said, and the principal part of the fete was over; but the Virgin is not disrobed and returned to the obscurity of her chapel until eight days have passed from the beginning.

There could be no doubt in the mind of any one who has passed this week in Antwerp that it is a thoroughly Roman Catholic city. Of the 240,000 inhabitants, not more than 20,000 are Protestants, and they are, for the most part, foreign residents or the descendants of Dutch, Swedish, German or English parents. The Spanish occupation left the Romish church firmly planted in this division of the Netherlands. Some practical clew to its methods may be gained by a visit to the Steen. This is the old prison which formed a part of the Castle of Antwerp, and was used for the detention of criminals long before the Inquisition began. The building has been enlarged within a few years, the cells above ground have been more or less changed and are now used for a museum. The collection is very heterogeneous and hardly worth inspection, but the balls and chains, the handcuffs, and the chopping block and knife with which the wrists of parricides were cut, suggest some of the horrors enacted here. From the floor where you enter you descend a flight of stone steps to the six underground dungeons. The walls are bricked and very thick; water trickles down them; the only light and air that can enter come from a little grated opening communicating with the court, too high for any one to reach from the cell. Here, from the earliest time, persons who were arrested for a crime were confined and sentence was pronounced upon them, proportionate to their confession. It was the custom for the officers of the law to go to the dungeon in the middle of the night, awaken the prisoner and apply the torture; this was of various forms, stretching him on a board till the joints were dislocated was one method, another was crushing the legs between planks.

In this way the confession was extorted; then followed the punishment. As late as the sixteenth century thieves were hanged and counterfeiters boiled in oil.

From the first quarter of that century the Steen was chiefly used as a place of confinement for Protestants. The pillar and the chain by which they were fastened to it, still stand in one of the dungeons; in another there is a cistern in which some were drowned. The record of painful torture and triumphant death in Antwerp is like that in other places. It is well that the Steen is preserved, and well for us who live in this tolerant age to visit it, and realize in some faint way what it once cost to confess an unauthorized faith.

The history of the printing of the Bible in Antwerp is a remarkable one. The first New Testament translated into Dutch from Luther's Testament was pub lished here by Hans van Brmunde in 1521. Jacques van Liesveld printed the whole Bible in Dutch and in Flemish, but when he brought out a fourth edition in the latter language it cost him his life. The light was spreading too fast. He was burned in Antwerp in 1545. Less than twenty years afterward, in 1567, Philip II., of Spain, advanced 21,200 florins ($7,066) to Christophe Plantin, of Antwerp, to print a polyglot Bible, and sent one of his chaplains to correct the text. One of the eight volumes in five languages arranged in parallel lines, in which this work appeared, is to-day the most valued treasure in the Plantin Museum. The British Museum has offered thousands of pounds for it, but cannot get it. This Bible was published in 1573; it is on parchment, the spacing is wide, the type in Hebrew, Greek, Latin and the two modern languages, is clear cut, and the ink is black to-day.

This work was the foundation of Plantin's fortune; he became at once the court printer; all the missals, breviaries, offices of the Virgin and other books for Philip's wide dominion were printed here by thousands.

A Frenchman by birth, Plantin came to Antwerp when a young man, considering it the best place in northern Europe to settle. In 1577 he received the appointment of printer general to the King of France, and later the Duke of Savoy made him tempting offers to become the head of a printing establishment which he wanted to found in Turin. But Plantin was too firmly rooted in the city of his choice to be willing to move. He had already settled his family in a part of the house which, by successive additions made by him and his descendants, became the home, printing office, book shop and counting house of the famous Plantin-Moretus publishing firm. This building, with its treasures accumulated through three centuries, was bought by the city in 1876, and forms a unique museum, so interesting that it is well worth a voyage from New York to Antwerp to see it. The house, with a very unpretentious front on the Marché du Vendredi, surrounds a large paved rectangular court, upon which many of the rooms look. It is built of brick and is three stories high. The interior, with its Flemish tapestries and embossed leather wall covering, its dark oak doors and ceilings, its quaint furniture and rich collections, contains not only the history of a remarkable family, but virtually the history of the arts of printing and engraving. The first room we enter contains nothing of so much interest as Plantin's coat of arms in a large painting by Erasme Quellin. It gives the keynote to the man's life. His motto was "Labore et Constantia," and they are symbolized by a man holding a spade and a woman holding a cross.

We find in the next room the very first book Plantin ever printed. It is a translation into French of an Italian work by Giovanni Michele Bruto; the title is "L'institution d'une fille de noble maison." The original and the translation are on opposite pages, the first capitals are ornamental letters and the preface is the publisher's own composition. Plantin early became a collector of choice manuscript books on vellum, and here they are in all the beauty of scroll margins and elaborate colored frontispieces, and rich in illustrations painted with painstaking accuracy.

The bindings of many are beautiful. These old books, hand made from cover to cover, were the models Plantin had for his own work. From printing religious books under Philip's orders, he widened his scope to include scientific, historical and philological literature. Here is a botany which might well be imitated to-day, for the illustrations of the plants from root to blossom are in colors and most carefully drawn. The text is in Flemish or Dutch. Near it is a large atlas of colored maps—an enormous book in Italian. It is open at the map of Ireland. Not only are the names of towns and villages on it, but private houses are represented, with the name of the owner given, public buildings are drawn, the lakes have their islands shown, the surrounding sea has its boats afloat and its characteristic fish in sight.

He hesitated at no language. We find Greek in one column and Latin in the next in some works; Hebrew, Flemish, Dutch, Spanish, Italian and French are side by side. The year before his death, which occurred in 1589, Plantin published no less than fifty-two books.

He had no sons, but the husband of his eldest daughter, Jean Moretus, succeeded him in the business, and it was continued by his descendants. The most eminent of these was his son, Balthazar. Though half paralyzed, he had remarkable intellectual force. He enlarged the house, making important changes in it, and published many valuable works, beautiful in letterpress and illustration. Rubens was his intimate friend, and it was during his regime that the family portraits, which are among the best treasures of the museum, were painted by that master.

A bust of this Balthazar Moretus is above the portico, opposite his grandfather's, in the court. He had a strong but genial face; his motto was "Stella duce." He was succeeded by his nephew, Balthazar II., who was the last to produce very fine editions. An inventory of his goods made in 1602 showed that he was worth 2,000,000 francs.

The family portraits by Rubens, and others by less renowned artists of both earlier and later time, adorn the walls of the large room in which the rare old books and some of the first of Plantin's works are arranged in cases. Art less interesting than these is the collection of manuscripts, designs for illustrations, and letters and receipts from the most eminent men of the times.

The drawing room has its walls covered with Flemish tapestry, the prevailing colors blues'; the dark oak chairs have twisted rungs and are covered with leather. The most curious object in the room is a piano; it is what we should call a square piano, but has the keyboard at one end; the cover is open, because it has painted upon the inside a copy of Rubens' picture, "St. Cecilia."

Now we come to the business part of the establishment. The shop has on the wall a long list of books prohibited by the church to be read. It is alphabetically arranged and includes many published by the house. There are many books in cases; those with heavy iron clasps and less formidable ones side by side; here is the counter over which they might have been sold, if a customer had come for them. "The back shop," opening out of this, was evidently the private office; here on a shelf are piles of letters or papers tied up in bundles; the desk has its fresh file hanging close beside the inkstand. On the table the dish of pipes looks inviting, but the stiff little chairs which the host had to offer are not comfortable enough to tempt the customers to linger long after the business was transacted.

Beyond this is the "Room of the Correctors." This is admirably arranged for the purpose. A large table is raised above the floor and placed close to the windows; high backed, comfortable benches stand at each end of it; these were the seats for the proofreaders. On the opposite wall we read the names of the twenty men who served in this capacity between 1558–1608. In the center of the room a table is covered with piles of leaves of books and sheets of music with proofreader's corrections, just as they left their hands ready to go back to the printer. The room is further furnished with carved oak cabinets and chests of drawers and an open bookcase with the manuscripts still in it.

Beyond is a room containing type of all kinds in cases, and opening out of this is the large printing room, with seven presses. The first one Plantin used is here, primitive enough it looks too; so do the others; they are all hand presses, but the work done upon them is not often, if ever, excelled by the improved, complicated presses now used. This room looks exactly like a well regulated establishment, put in order at night, so that everything may move smoothly the next morning.

The fact is that on rare and important occasions the presses are used to-day; for instance, when the Lord Mayor of London, with his suite, his coach and outriders, and the rest of his emblems of pomp and power, paid a visit to the Exposition and was entertained by the Burgomaster of Antwerp, the menus for the banquet were printed here.

The second story of the old mansion is not a whit less interesting than the first; each room has its special collection rich enough to be worth studying for days. Nothing in the first was quite so fascinating to me as a volume of Froissart, with corrections in its margin made by Plantin himself; it was his intention to publish a new edition in French, and this was the preparatory work, but it was never finished. However it does its share in confirming the impression received very soon after entering the museum, that Plantin was not only a printer and bookbinder of the most accomplished order, but was a scholar also; and when we read his graceful French verses written on the occasion of the visit of the Prince and Princess of Orange to his printing house in 1579, we know that he fell not far short of being a poet. What is known as the "little library" is really a large collection of books, crowding the cases from floor to ceiling in a good sized room; many are very ancient looking with their heavy dark leather bindings, and probably have not been opened for generations.

What can I say to give any accurate idea of the collections of wood and copper engravings? Here are cases after cases filled with the blocks used in the illustration of the books; there are all sorts of subjects, animals for natural history, plants for a botany, scriptural scenes, portraits, etc., all beautifully cut on oak blocks. There are two or three narrow rooms with their walls lined with copper plates and the engravings made from them hung side by side; a great many of these are by Rubens and Van Dyck, and include such subjects as the "Adoration of the Magi" and "The Miraculous Draught of Fishes," known as among the great pictures that Rubens made. Here is the evidence that both these masters had their share in making the printing house famous.

The third story contains a foundry, with all its necessary appointments: a forge, crucibles, dies, matrices of letters in many languages, music type, tools of many sorts; in short, the appliances for making and mending whatever could be needed in the printing house. The largest room in the building is on this floor, and is known as the "large library." It is lighted by windows on one side looking on to the court; between them and on the other three sides of the room, bookcases extend to the ceiling and every one is full. Here

the distinguished curator, M. Max Rooses, is installed with the gathered treasures about him—an object of envy, probably, to new people every day in the year. There are many thousands of volumes. Let me advise any lover of the art of letters, who visits Antwerp, to give at least two whole days to this museum, though even then he must not expect to be satisfied, for much will still have had but a passing glance.

I have said that Antwerp has always been a commercial city. In the Plantin Museum one feels that the influence in the world of thought which has gone forth from here has not been less notable. But, after all, her artists are the men Antwerp seems to be most proud of. The three avenues along the park are named after Rubens, Quentin Matsys and Van Eyck; the fine bronze statue of David Teniers the younger, in Teniers Place, is one of the most conspicuous monuments. Van Dyck's marble statue is in the old part of the city, in a spot far more obscure than his admirers like to find it. But the Palais des Beaux-Arts, built between 1879 and 1890, is at once the pride of the city and the best monument to her artist sons, because it contains many of their choicest works. A description of the building and its treasures must be reserved for a later letter. A. D.

Antwerp, 1894.

CAN ANTS TALK?

I WAS one day standing in my garden near the trunk of an old willow tree, up which a scattered line of ants was crawling. After a time I observed an occasional straggler coming down in the opposite direction. Here and there a couple of ants, ascending and descending, chanced to meet; but there was no stoppage and no talk. Presently, at about five feet from the ground, I smeared a little hollow in the trunk with a large spoonful of thick treacle, to see how long it would remain undiscovered. I then went away for a short time, and on my return found about a dozen ants busily feasting on the treasure. A minute or two later one of the feasters crawled slowly down the trunk with heavy feet, and when near the ground met a friend, whom he suddenly arrested on his way up, and with his antennæ, which he plied vigorously, held a good talk. What was said I know not, but the friend knew, and thereupon marched steadily on up the tree to the newly found treasure. Meanwhile, the bearer of the good tidings made his own way quickly back to the nest, a few yards off in the grass, to which I watched him. He was soon lost to view, but, beyond all doubt, soon spread the news of treasure trove throughout the colony. Within half an hour of that time a long, unbroken line of hungry ants was marching direct to the tree, making straight for the feast, remaining there for a time, and then returning to the nest in another line on the other side of the willow. This process of ascending and descending termites went on for some hours, in fact, until dusk, when the numbers of advancing guests grew less and less, and finally ceased. Before it was dark not a single ant was to be seen, though early the next morning a fresh band of adventurers set out in the same fashion, coming and going all day until every morsel of the sweets had disappeared. Here, therefore, clearly some talk about the surprising dainty had taken place between the two ants meeting on the road to it, while tidings had been carried to the colony, which at once roused all the inmates to go forth direct to the feast, possibly led by the very guide who had first discovered it. So much for the general intelligence which enlightens and guides the whole life and work of this wise nation of insects.—Public Opinion, from Quiver.

PHILIBERT COMMERSON, "THE KING'S NATURALIST."

ONE of the most successful exploring and scientific expeditions of the eighteenth century was that of Louis Antoine de Bougainville, which starting from one of the ports of France in the last days of 1766, passed through the strait of Magellan and entered the south seas, still for the most part unexplored; sailed through the Paumotu Archipelago, discovering several islands then yet unknown; visited Tahiti; touched the New Hebrides, passed the eastern coast of Australia, the Louisiade Islands, and the Solomon Islands; stopped at New Ireland to repair the ships; passed the northern shore of New Guinea; visited Booro, in the Moluccas; and returning, reached St. Malo in March, 1769. Not the least among the scientific gains of the expedition were those in botany, and these accrued wholly through the fidelity to science and diligent industry of Philibert Commerson, than whom, says the Edinburgh Review, "no explorer of the globe ever conveyed to Europe so large a number of valuable plants, previously unknown."

Commerson was recognized in Europe, though personally but little known, as one of the first botanists of the age. He was the correspondent of Linnæus, the friend of Haller, and the colleague of the two Jussieus. He was the grandson of a retired nobleman of the days of Louis XIV., who had dropped the de distinctive of his rank, and the second son of Georges-Marie Commerson and Jeanne-Marie Mazuyer, and was born at Chatillon-les-Dombes, in Burgundy, November 18, 1727. He studied while a child under a Gray Friar at Bourg-en-Brosse, who became interested in him, and taking him on his daily walks, inculcated in him the first principles of botany and a love of plants and of natural history. The district abounded in fish ponds, and wandering among them he gained a familiarity with fresh water fish to which may be attributed his subsequent skill as an ichthyologist; and "his facility in manipulating, preserving, and drying certain fit specimens of the smaller fry, like plants, between sheets of coarse paper, first practiced by him for scientific purposes," was evidently acquired by him during this period. After two years at Bourg, he was sent to the Benedictine College near Macon, about 1742, to study for the law; but the scientific books of the abbey library had more attractions for him than the law books, and he was fonder of outdoor life than of studying his dry text books. His father, willing that he should follow in the direction of his tastes, sent him to the University of Montpellier to read for the medical degree in 1747. He had already begun the preparation of a herbarium, and spared no efforts to make it the most complete in existence.

He spent four years at Montpellier after taking his degree, and in botanizing in the Cevennes, the Pyrenees, and Provence, and on the littoral of the Mediterranean. He soon became known throughout Europe as a naturalist of exceptional talent and experience. He was introduced to Linnæus and was commissioned by him to describe the fishes of the Mediterranean for the museum of Queen Louisa Ulrica at Dronningholm, near Stockholm. He prepared a list of all the botanists who had suffered in the pursuit of their calling, entitled the Martyrologie de la Botanique, in which he came near having his own name recorded even thus early, having been poisoned by the saliva of his own dog gone mad, and he wrote to one of his friends that he expected some day to figure upon the roll. This work seems never to have been published, and it is not known where the manuscript is. Coming to Dijon in his travels, M. De Beost, an officer of the states of Burgundy, gave him the privileges of his fine garden, glass houses, and library. Having explored Savoy, he visited the mountains of Switzerland, and, calling upon Voltaire at Geneva, received from him the offer of a secretaryship, which he declined. Then he settled down for a time at Chatillon, his native home, where he put himself in communication with correspondents who furnished him seeds and plants. He studied and explored and experimented with a reckless devotion which called forth from Lalande another prediction that his zeal would some day kill him. His overwork resulted in fever, in the convalescence from which he made the acquaintance of the young woman—"a sensitive plant," he called her—who became his wife, a daughter of M. Jean Beau, who died after two years of happy married life, leaving a son who survived him many years. To the memory of his wife, making a fanciful translation of her maiden name, Beau, he dedicated the genus Pulcheria—a plant not distinctly identified, but which was described as bearing a fruit that inclosed two kernels united in the shape of two hearts.

He removed to Paris in 1764, where, introduced by Lalande and Bernard de Jussieu, he was readily welcomed into the inner circle of learned society and gained the position and recognition he merited. In October, 1766, Commerson was appointed by the French Minister of the Marine, on the recommendation of Poissonier and the Abbe Lachapelle, of the Academy of Sciences, "botanist and naturalist of the king" to Bougainville's expedition of circumnavigation, then in course of organization at Nantes and Rochefort. The title given him was very grateful to him on account of the privileges it brought; that of botanist to the king had been conferred on only two or three men of science, and always led to a pension, while that of naturalist was a distinction which no one before him had obtained. He was first directed to draw up a report regarding the class of observations on natural history which he proposed should be carried out during the expedition. It suggested observations in three kingdoms of nature, animal, vegetable and mineral, to which was added a fourth class of physical and meteorological observations. "The class of quadrupeds," he said, "being subordinate to man, that being should always first attract the attention of the traveler naturalist. . . . The first shade after man is that of the anthropomorphic animals or apes with a human figure, of which it would be desirable to know all the series, because they establish an insensible passage from man to quadrupeds."

Before leaving Paris for his voyage, Commerson made his will, in which he provided for the endowment as a Prix de Vertu of a medal of two hundred livres, bearing on its obverse face an inscription signifying that it was a reward for the practice of virtue, and on the reverse one signifying that the unworthy "P. C." had dedicated it. It was very like the Montyon prizes, afterward established and carried into effect. Having set out from Rochefort, after considerable delay, the expedition reached the mouth of the Rio de la Plata in May, 1767, and remained for some time at Montevideo to repair damages suffered from a storm. Here Commerson was astonished at the superfluity of horses and cattle, and wrote to his brother-in-law, further: "I have not failed to reap a fruitful harvest of plants, birds, and fishes, and I am anxious that nothing should escape me; but what can I do? I am neither an Argus nor a Briareus; a single day's hunting, fishing, or even a walk places me in the embarrassment of Midas, under whose hands everything became golden. Ofttimes I do not know when or how to begin, and I have scarcely time to eat or drink, so that my excellent friend, our good captain, is obliged to forbid my lamp being kept alight after midnight, because he has foreseen that I should deprive myself of sleep all night to gain sufficient time to examine all which is before me. The keen admiration which seizes me in viewing so many varieties, most of them new and unknown to science, has forced me to become a draughtsman."

From Montevideo the vessel, L'Etoile, proceeded to Rio Janeiro. In one of his excursions Commerson noticed some trees having a rosy mauve or magenta tint, which further examination showed him was given them by their brilliantly colored bracts. They were trees of a new genus, which he named Bougainvillea, after his commander. The genus has become familiar in conservatories. Returning to the Rio de la Plata, Commerson declined an invitation from the viceroy, Don Francisco Bucarelli, to go with him across the Andes to Chile and Peru. Proceeding onward again in November and December, 1767, the expedition sailed into the strait of Magellan. Thence they went northwesterly into the Pacific Ocean; passed the Paumotu, or Low Archipelago; and visited Tahiti, of which Commerson has left a famous description in a letter to Lalande; continued to sail westwardly; sighted Samoa; were perplexed by the Great Barrier Reef, and had to make a back track along the Louisiade Archipelago to the Solomon Islands; between New Britain and New Ireland; along the northern shores of Papua; thence to Batavia; and finally, to Port Louis. Here M. Poivre, intendant of the colony, had orders from the authorities at home to retain Commerson for service under his direction; while Veron, the astronomer, was directed to proceed to India, to observe the forthcoming transit of Venus. Commerson was the first European to ascend the native volcano of Bourbon and to make a complete collection of mineralogical specimens from its hardly accessible craters. His account of a pygmy tribe inhabiting the mountain regions of Madagascar, after having been long contradicted, has recently been confirmed by the Rev. E. O. MacMahon, of the Society for the Propagation of the Gospel.

Commerson's career now soon came to an end. Among the results of political changes in the colony and in France were the withdrawal of ministerial patronage from him, the stoppage of his salary as naturalist to the king, and his dismissal. His health had already given way in consequence of the exposures to which he had subjected himself, and he was suffering from dysentery and rheumatism. He gave himself up to the study of the flora of Mauritius, writing to his friend Lemeunier: "My plants, my dear plants, have consoled me for all. I have found the nepenthe, the sweet assuagement of cares." He sought rest in another part of the island, but died March 14, 1773, at the house of M. Bezac, a planter, near Flacq.

Commerson left his collections of plants, fishes, minerals and manuscripts, thirty-two cases in all, to the Royal Museum of Natural History in Paris. They included, with two hundred folio volumes of herbaria, five thousand plants, of which three thousand species and one hundred and sixty genera were new to science. —Popular Science Monthly.

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